The RUBBER AGE

September, 1947

● If you wish to eliminate mica and other dusting powders you should try

VANFRE

It is a liquid developed for coating rubber prior to curing in a lead jacket. Apply as a dip, spray or by brushing.

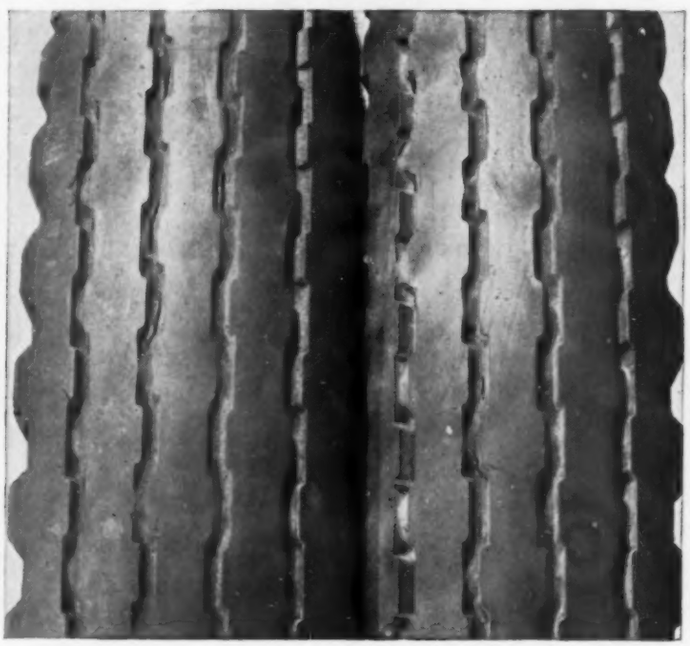
R. T. VANDERBILT CO., Inc.

230 Park Avenue, New York 17, N. Y.

R·T·VANDERBILT·CO·INC·AMERICAN PRODUCTS

Fortify Tread Stocks Against Flex-Cracking

USE DU PONT ACCELERATOR 2MT



A comparison of tires after 12,000 miles of service is evidence of the improvement in resistance to flex-cracking obtained by the use of Accelerator 2MT in rubber treads. (Tire on the right was made with Du Pont Accelerator 2MT.)

MANY RUBBER CHEMISTS have been disappointed with the degree of resistance to flex-cracking obtained by substituting rubber for GR-S in tire tread stocks. There is little doubt that increasing the percentage of natural rubber cannot alone solve the problem of flex-cracking. Correct acceleration is an important factor in improved flex-resistance. Accelerator 2MT is outstanding in this respect. For example, in the tire treads shown here resistance to flex-cracking was greatly improved when Accelerator 2MT was substituted for MBT. That's why tire technologists are using Accelerator 2MT to solve flex-cracking problems.

Other important advantages of Accelerator 2MT in rubber stocks:

Exceptionally low heat build up.
Little tendency to revert during long curing.
Excellent resistance to tear at elevated temperatures.
Outstanding resistance to heat and aging.

These characteristics suggest the use of Accelerator 2MT in compounds for dynamic service where the vulcanizate is exposed to severe mechanical working, such as in tires, belts and vibration dampeners.

For more complete information on Accelerator 2MT, write to:

E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Division, Wilmington 98, Delaware.

DU PONT RUBBER CHEMICALS

E. I. du Pont de Nemours & Co., (Inc.), Wilmington 98, Del

BETTER THINGS FOR BETTER LIVING ...THROUGH CHEMISTRY

DU PONT

Tune in to Du Pont "Cavalcade of America," Monday nights—8 p. m. EST, NBC

THE RUBBER AGE, published monthly by The Palmerton Publishing Co., Inc., Printing Office, East Stroudsburg, Pa. Editorial and Advertising Offices at 250 West 57th Street, New York 19, N. Y. Entered as second class matter October 20, 1933, at the Post Office at East Stroudsburg, Pa., under the Act of March 3, 1879. Subscription in United States, $3.00 a year; Canada, $3.50; Foreign, $4.00. September, 1947. Vol. 61, No. 6.

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DETROIT

★ EXCELLENT AGE RESISTANCE

RESILIENT parts made from HYCAR American rubber resist the aging effects of air, sunlight, ozone, heat, cold, and all other types of oxidation. That's why they *stay* resilient—and stay on the job for a long, long time.

Other important properties of HYCAR American rubber are shown in the box at the right. And it's important to know that these properties may be had in an almost limitless number of combinations—each compounded to meet a given set of service conditions.

We make no finished products of HYCAR. But we urge you to ask your supplier for parts made from this versatile material. You'll learn for yourself that it's wise to use HYCAR—in difficult or routine applications—for long-time, dependable performance. For more information, please write Dept. HB-9, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio.

CHECK THESE SUPERIOR FEATURES OF HYCAR

1. EXTREME OIL RESISTANCE — insuring dimensional stability of parts.
2. HIGH TEMPERATURE RESISTANCE—up to 250° F. dry heat; up to 300° F. hot oil.
3. ABRASION RESISTANCE—50% greater than natural rubber.
4. MINIMUM COLD FLOW—even at elevated temperatures.
5. LOW TEMPERATURE FLEXIBILITY—down to —65° F.
6. LIGHT WEIGHT—15% to 25% lighter than many other synthetic rubbers.
7. AGE RESISTANCE—exceptionally resistant to checking or cracking from oxidation.
8. HARDNESS RANGE—compounds can be varied from extremely soft to bone hard.
9. NON-ADHERENT TO METAL—compounds will not adhere to metals even after prolonged contact under pressure. (Metal adhesions can be readily obtained when desired.)

Hycar
Reg. U.S. Pat. Off.
American Rubber

B. F. Goodrich Chemical Company
A DIVISION OF THE B. F. GOODRICH COMPANY

GEON polyvinyl materials • HYCAR American rubber • KRISTON thermosetting resins • GOOD-RITE brand chemicals

This advertisement appeared in a long list of carefully selected business papers TO HELP YOU SELL parts made from HYCAR.

PHILBLACK-O LAUGHS AT ABRASION!

Philblack-O lets your rubber products take a whale of a beating and still come up smiling! It's truly remarkable what wonderful abrasion resistance Philblack-O imparts! We've put tires made with Philblack-O through test after test . . . in the laboratory . . . on the road . . . and all with good results. We think you'll be delighted with the performance, too, if you put this new "magic black" to work for you.

Although abrasion resistance is his most startling faculty, Philblack-O has many other claims to fame. Send for a trial order today. Find out for yourself the many places in which Philblack-O can be of value.

PHILLIPS PETROLEUM COMPANY

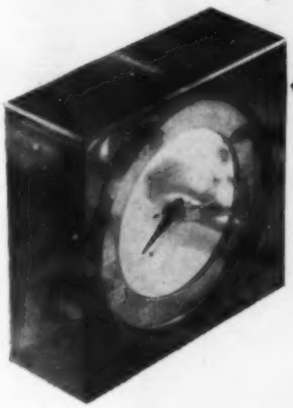
Philblack Division

EVANS SAVINGS AND LOAN BUILDING • AKRON 8, OHIO

To help you select the right material for your product

Geon

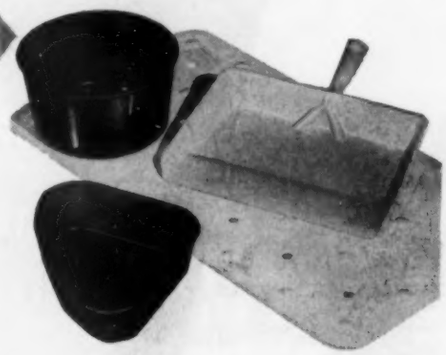
GEON is the name used to designate a group of thermoplastic resins which impart to finished products such properties as resistance to water, chemicals, abrasion, sun, mildew and most other normally destructive factors. GEON can be pressure or injection molded, extruded, calendered or cast into sheet or film. It is available in powder, paste-forming resin, polyblend (GEON-HYCAR) and latex forms. Products made from GEON may be brilliantly or delicately colored. The suitcase shown here is an example of a product made from calendered sheet



KRISTON

KRISTON designates a group of thermosetting resins with many unusual properties. Products made from KRISTON may have excellent optical properties, unusually good electrical properties plus resistance to most normally destructive factors. As the clock at the left shows, products made from KRISTON can be most decorative in this and other forms such as jewelry, buckles, buttons, frames, desk sets, coasters, ash trays and many others. KRISTON is a relatively new product, and we invite suggestions and inquiries as to possible applications.

Hycar



HYCAR is the name applied to a group of American rubbers that have found wide usage in both consumer and industrial products. Typical are the household items shown at right which, like other products made from HYCAR, resist water, grease and oil, heat, aging, abrasion and many other destructive factors. HYCAR OR-15 is exceptionally oil resistant, and is an important material in the oil fields as well as in general industry. HYCAR and GEON may be blended for certain uses to impart to finished products the most favorable properties of each. (Products courtesy of Wooster Rubber Co., Wooster, Ohio.)

Good-rite

GOOD-RITE is the brand name of a constantly growing group of widely diversified chemicals. GOOD-RITE Erie, for example, is one of several outstanding chemicals for the rubber industry. GOOD-RITE p.e.p.s. is a new fungicide that promises great things for the future in agriculture. And there is a large group of intermediate organic chemicals which are finding new uses daily. The GOOD-RITE name is growing, and is certain to become an important one in many different industries.

We make no finished products from any of these raw materials. But we will be glad to work with you on any special problems or applications. For more information, or for an informative glossary of technical terms used in the Plastics and Rubber Industries, please write Department R-9, Rose Building, Cleveland 15, Ohio. In Canada: Kitchener, Ontario.

B. F. Goodrich Chemical Company

A DIVISION OF THE B. F. GOODRICH COMPANY

GEON polyvinyl materials • HYCAR American rubber • KRISTON thermosetting resins • GOOD-RITE chemicals are registered trade marks

Good-rite
VULTROL
for use in American rubber compounding
to prevent scorching, and for recovering
scorched stocks
GOOD-RITE AND VULTROL REG T M U S PAT OFF

For technical data please write Dept. CB-9

B. F. Goodrich Chemical Company

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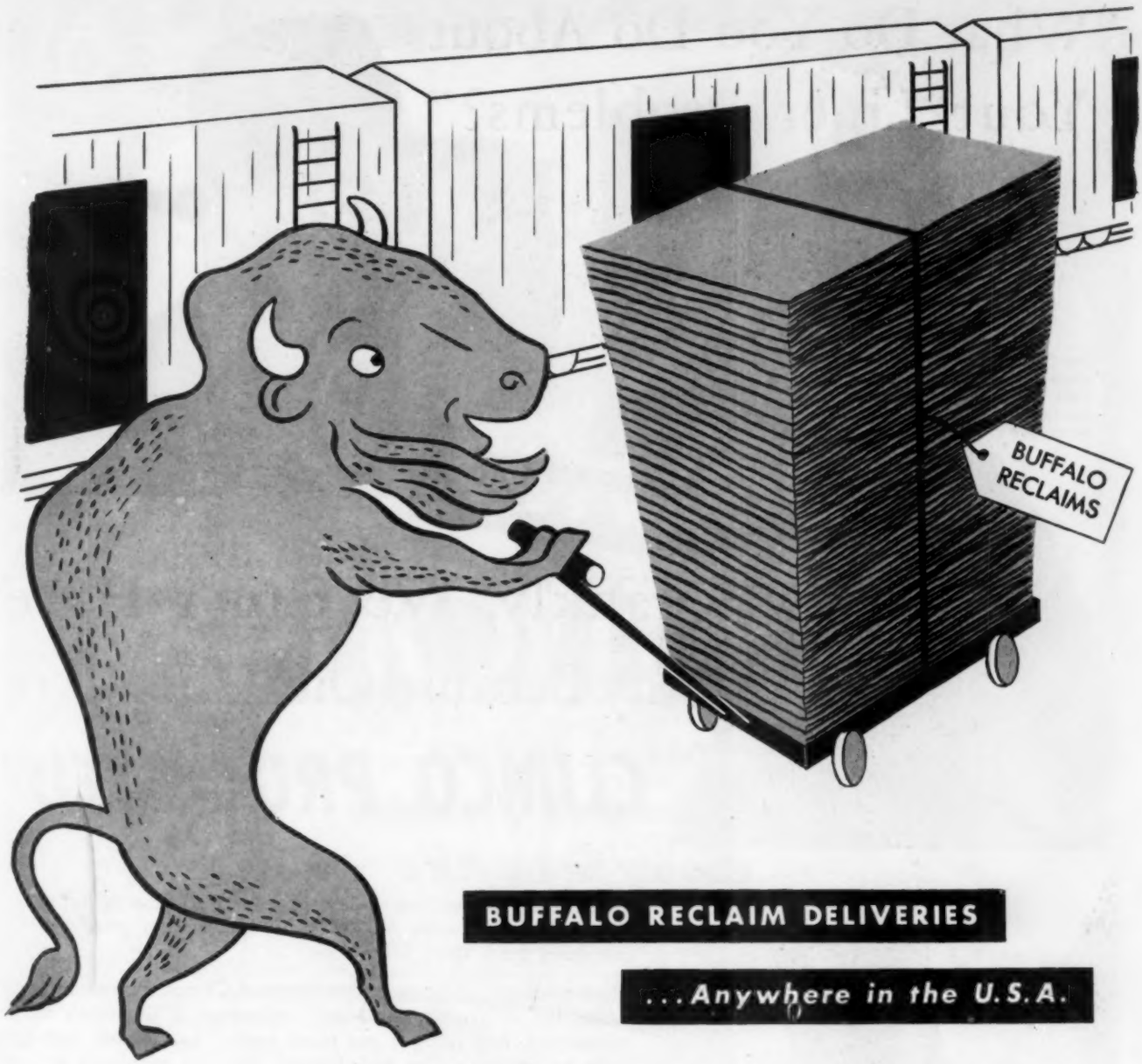
ROSE BUILDING, CLEVELAND 15, OHIO

GEON polyvinyl materials • HYCAR American rubber • KRISTON thermosetting resins • GOOD-RITE chemicals



BUFFALO RECLAIM DELIVERIES

...Anywhere in the U.S.A.

Whether you do your compounding in Worcester or Waco, there's the right grade of Buffalo reclaim for your needs. Just tell us the properties you want—heat or abrasion resistance, redness, whiteness, quick milling qualities, tensile strength, etc. We'll supply you with tested, uniform, high quality reclaims that fit into your processing picture *economically*.

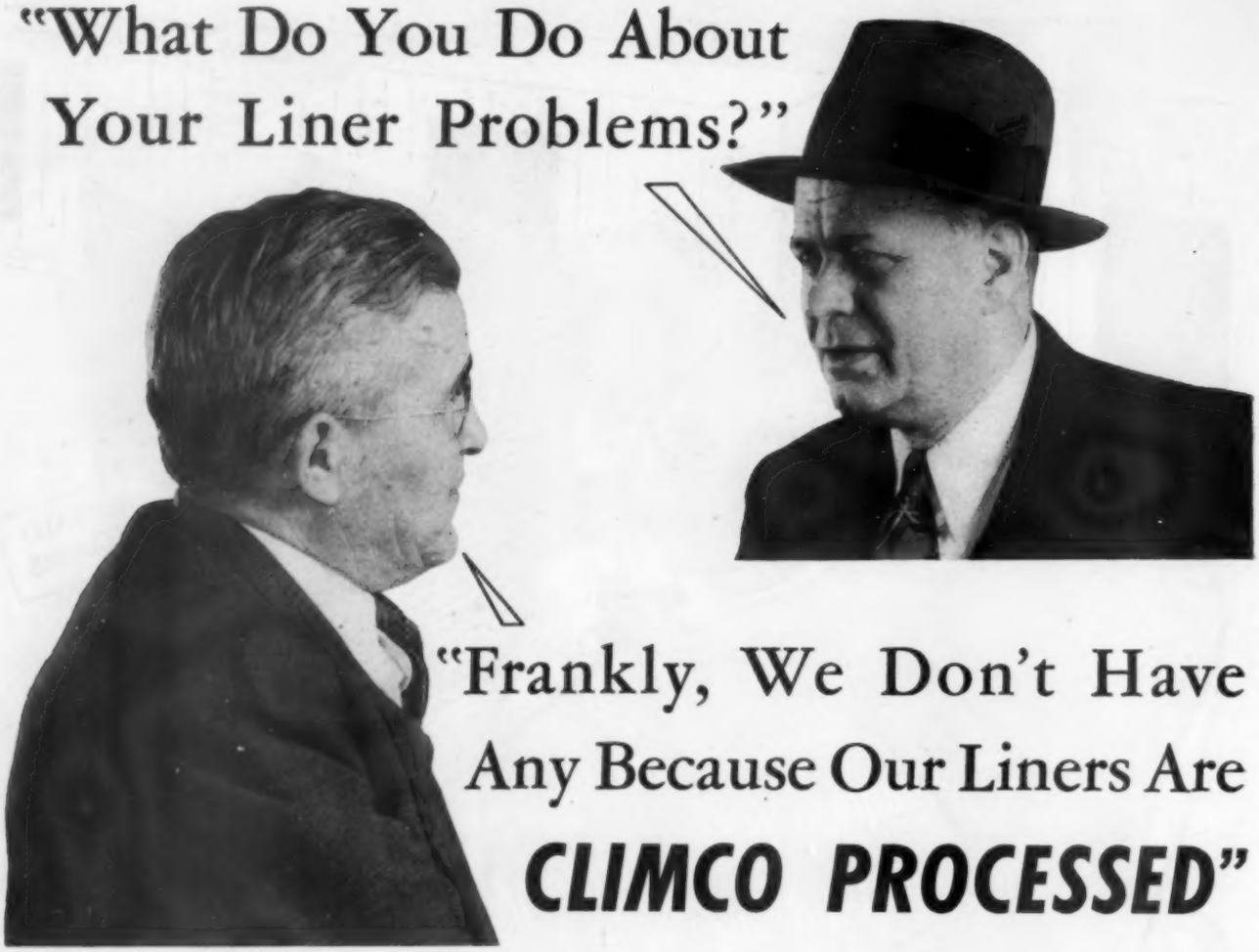
U. S. RUBBER RECLAIMING CO., INC.

500 Fifth Ave., New York 18, N. Y. (Plant at Buffalo, N.Y.)

TRENTON . . . H. M. Royal, Inc., 689 Pennington Ave.
TORONTO . . . H. van der Linde, Ltd., 156 Yonge St.

65 Years Serving the Industry Solely as Reclaimers

"What Do You Do About Your Liner Problems?"



"Frankly, We Don't Have Any Because Our Liners Are CLIMCO PROCESSED"

INFORMATIVE, ILLUSTRATED BOOKLET ON REQUEST

By insuring perfect separation of stock and liner, Climco Processing eliminates all the costly production problems resulting from stock adhesions.

Here are some additional advantages of Climco Processing: Liner life is greatly increased, tackiness of the stock is preserved, and gauges are more easily maintained. Latitude in compounding is enlarged, lint and ravelings are eliminated, and horizontal storage is facilitated.

For twenty-five years Climco Processed Liners have proved their worth to the rubber industry. Give them a trial in your plant.

THE CLEVELAND LINER & MFG. CO.
5508 Maurice Avenue • Cleveland 4, Ohio, U. S. A.
Cable Address: "BLUELINER"

LINERETTE INTERLEAVING PAPER
Treatment Contains
NO OIL OR WAX
Samples on Request

CLIMCO
PROCESSED LINERS

Serving the Rubber Industry for 25 Years

1,200 grams of GR-S, processed by conventional methods. Note small area and roughness, due to shrinkage.

1,200 grams of GR-S and Pliolite S-6, milled under identical conditions. Note larger area and smoothness of stock, due to elimination of shrinkage.

HERE'S WHY

PLIOLITE S-6

makes better molded, calendered, extruded goods

THE above photos illustrate one of the most important advantages of **PLIOLITE S-6** — *it prevents shrinkage* and thereby aids processing. That's one of the reasons it's a superior reinforcing agent for molded, calendered and extruded goods — not only in GR-S, but in Buna N, Neoprene and natural rubber, too.

When compounded with **PLIOLITE S-6,** molded items keep their shape better. Calendered products come out smoother. Extruded goods are smoother, too; more uniform in cross section.

What's more, **PLIOLITE S-6** provides more easily handled compounds, because it acts as a plasticizer at processing temperatures. Its reinforcement is positive — coupling extra hardness with negligible loss in elongation. Often elongation is increased.

At its new low price, **PLIOLITE S-6** is more economical to use than ever. Available as a powder for your own mixing, or in master batches in whatever synthetic you select. For complete information and sample, write: Goodyear, Chemical Products Division, Plastics and Coatings Dept., Akron 16, Ohio.

Pliolite—T.M. The Goodyear Tire & Rubber Company

GOODYEAR

THE GREATEST NAME IN RUBBER

WANTED
GR·S
BLACK COMPOUND STOCK
COMPOUND COST APPROX. 8c per lb.

TEST No.·8312
from the Barrett Rubber Laboratory

Use of Barrett BRS 700 rubber softener, Carbonex* S tar-hydrocarbon, plastic grade, and Cumar* resin, DX grade, to produce an inexpensive GR-S black compound stock with a Shore A hardness of 90 is shown in the following recipe and test data.

RECIPE	WEIGHT BASIS
GR-S	100.00
Carbonex* S tar-hydrocarbon, plastic grade	50.00
Cumar* resin, DX Grade	25.00
BRS 700	10.00
Channel Black (EPC)	50.00
Clay	125.00
Zinc Oxide	5.00
Sulfur	3.50
Benzothiazyl Disulfide	1.25
DPG	0.50
Total	370.25
Compounded Mooney Viscosity at 100°C (1.9 Inch Rotor)	59
Specific Gravity	1.44
Rubber Hydrocarbon, % by Wt.	27
Rubber Hydrocarbon, % by Vol.	42
Cost per Pound	$ 0.08 (Approx.)

Cure at 316° F (70 Lb)— 10 Minutes

Tension Data:	Unaged	Aged 24 Hrs. @ 100° C
Stress—P.S.I.—at 300%	950	—
Tensile—P.S.I.	1100	1200
Elongation—%	400	230
Hardness—Shore A	90	96

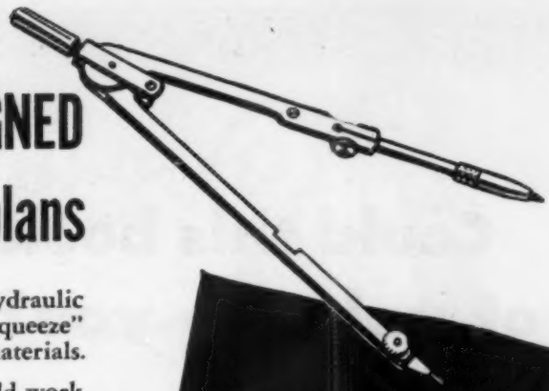
The recipe shown above combines the good processing and reinforcing properties of Carbonex* tar-hydrocarbon with the extending properties of Cumar* resin, and the softening and extending action of BRS 700. This compound, characterized by high hardness, extrudes and molds exceptionally well in spite of its low cost. Inquiries respecting the use of Barrett Rubber Compounding Materials are invited. Send for booklet and Rubber Laboratory Releases.

THE BARRETT DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.
In Canada: The Barrett Company, Ltd., 5551 St. Hubert Street, Montreal, Que.

Barrett*

*Reg. U. S. Pat. Off.

HYDRAULIC PRESSES DESIGNED to fit into your production plans



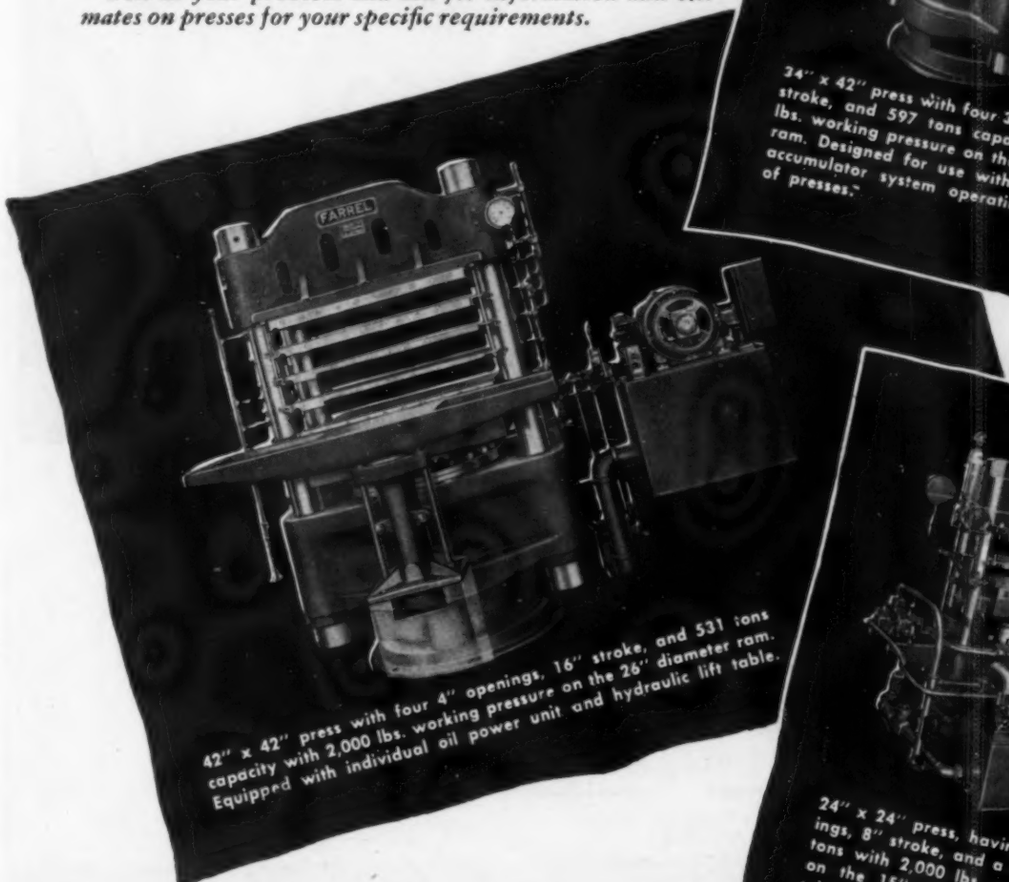
Here are three examples of the thousands of hydraulic presses we have designed and built for "putting the squeeze" on rubber, plastics, linoleum, tiling, and other materials.

F-B presses range from 12" square for small mold work up to any size required for molding large plastic sections, and for vulcanizing rubber belts, floor tiling, etc. Design and materials provide the strength required for minimum deflection.

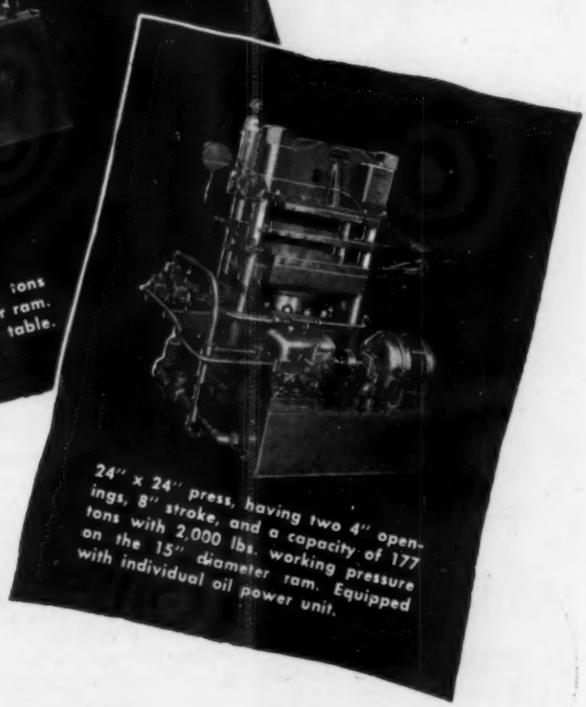
They can be made for any pressure and equipped with controls for fully automatic cycle operation or for semi-automatic or manual operation. Presses are equipped with individual pumping unit, integral with the press or mounted separately; or arranged for group operation from central pump and accumulator system.

Tell us your problem and ask for information and estimates on presses for your specific requirements.

34" x 42" press with four 3" openings, 12" stroke, and 597 tons capacity with 2250 lbs. working pressure on the 26" diameter ram. Designed for use with a pump and accumulator system operating a number of presses.



42" x 42" press with four 4" openings, 16" stroke, and 531 tons capacity with 2,000 lbs. working pressure on the 26" diameter ram. Equipped with individual oil power unit and hydraulic lift table.



24" x 24" press, having two 4" openings, 8" stroke, and a capacity of 177 tons with 2,000 lbs. working pressure on the 15" diameter ram. Equipped with individual oil power unit.

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.

Plants: Ansonia and Derby, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Boston, Pittsburgh, Akron, Chicago, Los Angeles, Tulsa, Houston.

F/B *Farrel-Birmingham*

FB-418

Could this book be of value to you?

"THE Wire in Your Tire" is a 24-page, richly illustrated book, brief in text. *Not* an engineering treatise, *not* a catalog, it has been prepared particularly for non-technical men in and associated with the rubber industry. However, many engineers tell us that they too have found it interesting and helpful. Its purpose is to give a broader, clearer understanding of the vital functions of steel wire in tire beads . . . a better knowledge of the exacting requirements and varied applications that are a part of the interesting tire-building operations.

You are welcome to a free copy of this book. Just drop us a card or note today. And, after you have gone over "The Wire in Your Tire", if you would like some additional copies for certain friends or associates, you'll find us glad to cooperate . . . as usual. *National-Standard Company, Niles, Mich.*

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Tire Wire, Fabricated Braids and Tape

ATHENIA STEEL
Clifton, N. J.
Flat, High Carbon, Cold Rolled Spring Steel

WORCESTER WIRE WORKS
Worcester, Mass.
Round Steel Wire, Small Sizes

WAGNER LITHO MACHINERY
Jersey City, N. J.
Lithographing and Special Machinery

AMECCO CHEMICALS

Announces

FLEXTENDER 3A

(VULCANIZED OIL)

A RUBBER SUBSTITUTE and PROCESSING AID—

SUPERIOR PHYSICAL PROPERTIES

ESPECIALLY USEFUL IN EXTRUDED PRODUCTS —FLOORING COMPOUNDS AND MIDSOLING STOCKS

Samples gladly furnished

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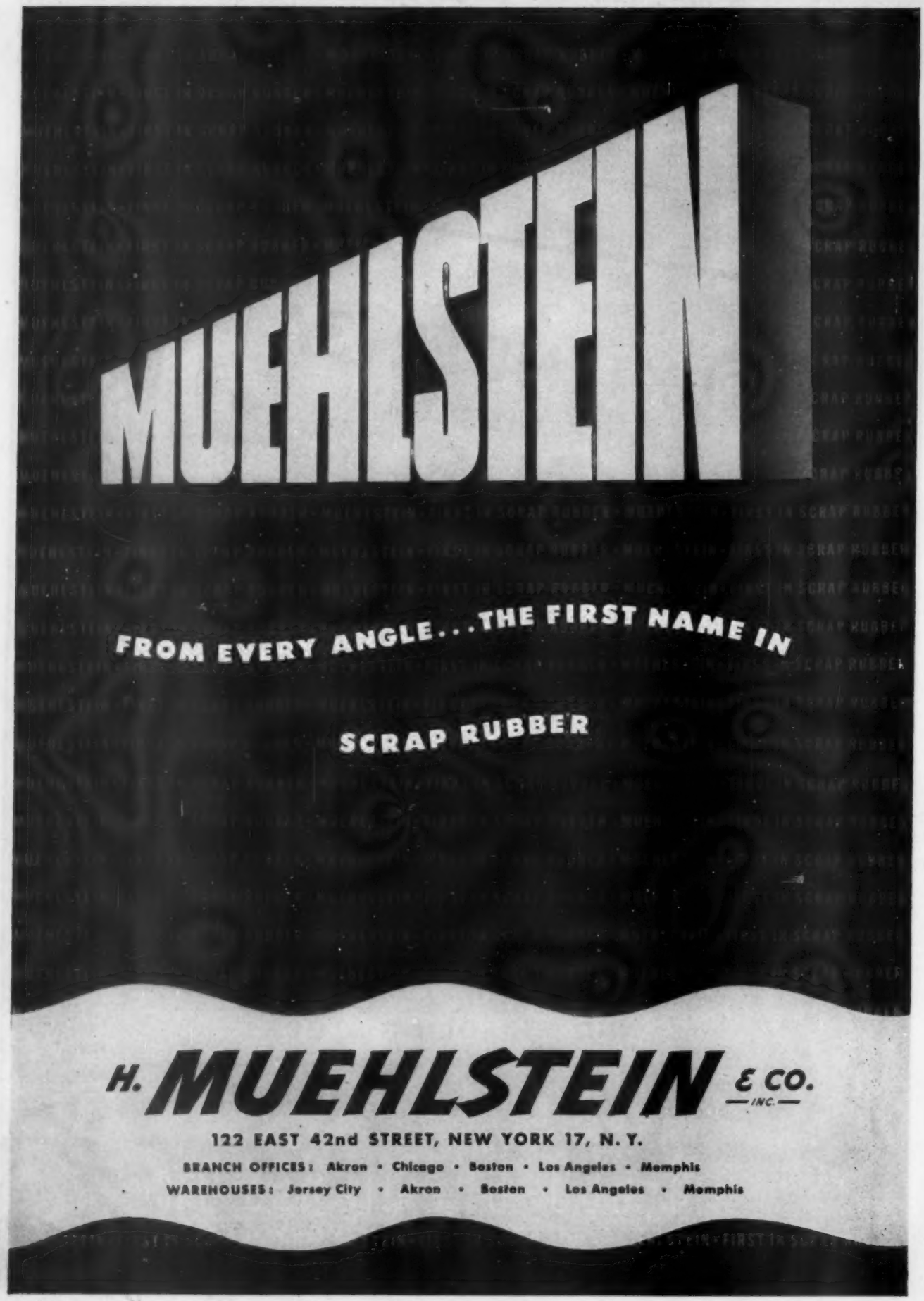
ESTABLISHED 1919 MURRAY HILL 2-3558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FROM EVERY ANGLE...THE FIRST NAME IN
SCRAP RUBBER
H. MUEHLSTEIN & CO. INC.
122 EAST 42nd STREET, NEW YORK 17, N. Y.
BRANCH OFFICES: Akron • Chicago • Boston • Los Angeles • Memphis
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DOUBLE-CHECKED CHEMICALS FOR THE RUBBER INDUSTRY

TETRAETHYLTHIURAM DISULFIDE

SHARPLES ACCELERATOR 62-0

PROPERTIES:

Appearance	cream colored powder
Specific Gravity at 20°/20°C.	1.17
Melting Point (approx.)	69°C.
Molecular Weight	296.4

USES:

AS A:

Primary Accelerator	Vulcanizing Agent
Secondary Accelerator	Retarder for neoprene

IN:

Latex	Inner Tubes
Wire Stocks	Mechanical Goods
Sponge Rubber	Heat Resistant Stocks
Tires	Non-Tarnishing Stocks

WITH:

Natural rubber	Nitrile rubber
Butyl rubber	Neoprene
Styrene rubber	

SHARPLES TRADE MARK CHEMICALS

SHARPLES CHEMICALS INC. PHILADELPHIA • NEW YORK • CHICAGO • AKRON

Announcement

• We beg to announce that MOORE & MUNGER have changed the name of their Clay Department to P. W. MARTIN GORDON CLAYS, INC., which incorporation took effect as of August 1st, 1947.

• With this incorporation, there has been no change in the personnel or any change in their sales policy or products for the sale of BUCA, CATALPO, PIGMENT 33, WHITETEX, AND SYNTHETIC 100 (Polyisobutylene produced by Standard Oil Co. of New Jersey)

• Our Mr. E. W. Schwartz will be technical sales representative as formerly along with Mr. W. H. Shields.

• We hope to have your continued use of our products.

P. W. MARTIN GORDON CLAYS

INCORPORATED

33 RECTOR STREET, NEW YORK 6, N. Y.

SUCCESSOR TO MOORE & MUNGER'S DOMESTIC CLAYS DEPARTMENT

Fabric Uniformity means Product Uniformity

BECAUSE THE UNIFORMITY of your rubber products can be only as good as the fabric employed, successful production depends, to a large extent, on the uniformity of the fabric used. MT. VERNON fabrics have *that constant uniformity*. Made from choice grades of cotton and woven under rigid laboratory controls, they make for consistent product quality. For better results—specify MT. VERNON fabrics.

uniformity makes the big difference

TURNER HALSEY
COMPANY
Selling Agents
40 WORTH ST. • NEW YORK

Mt. Vernon-Woodberry Mills

Branch Offices: CHICAGO • ATLANTA • BALTIMORE • BOSTON • LOS ANGELES • AKRON

From Tires for Motor Cars to Grips for Handle Bars

Dutch Boy: "It's true of almost every product . . . if it's made with rubber . . . *it's better made with Red Lead.*"

Plant Chemist: "Just why are you so sure?"

Dutch Boy: "First, experiments showed, then experience *proved,* that compounding rubber with #2 RM Red Lead gives the advantages listed on the right."

Plant Chemist: "But don't those advantages depend on what I make?"

Dutch Boy: "Yes, they do. You get all seven if you make tires; but *most* of them apply with other fields, too."

Plant Chemist: "But don't they depend on the base I use?"

Dutch Boy: "They apply whether you work with GR-S, GR-S-10, GR-M, GR-A or GR-I. Just let us know your specific application, and our technical staff will gladly supply literature and any other information you need. Drop a line to the Rubber Division of our Research Laboratories, 105 York Street, Brooklyn 1, New York."

CHOOSE YOUR OWN Rx REASONS FOR COMPOUNDING RUBBER WITH #2 RM RED LEAD

1. *Improved Heat Stability—Retention of Elasticity*
2. *Lower Heat Build-up—Cooler Running*
3. *Economical*
4. *Faster Curing Rate*
5. *Extended Curing Range*
6. *Excellent General Physical Properties*
7. *Safe Processing*

NATIONAL LEAD COMPANY—New York 6; Buffalo 3; Chicago 8; Cincinnati 3; Cleveland 13; St. Louis 1; San Francisco 10; Boston 6, (National Lead Co. of Mass.); Philadelphia 7, (John T. Lewis & Bros. Co.); Pittsburgh 30, (National Lead Co. of Pa.); Charleston 25, West Virginia, (Evans Lead Division).

If it's made with Rx RUBBER ... it's better made with Rx RED LEAD

SHELL DUTREX 6

Plasticizer and Extender for GR—S

Chemically and physically Controlled

Direct inquiries to:

SHELL OIL COMPANY, INCORPORATED

50 WEST 50th ST., NEW YORK 20, N. Y.
(East of Rockies Territory)

100 BUSH ST., SAN FRANCISCO 6, CALIF.
(Pacific Coast Territory and Western Canada)

SHELL OIL COMPANY OF CANADA, LTD., 25 ADELAIDE ST., EAST TORONTO, CANADA
(Eastern Canada)

TO MEET THE GROWING INDUSTRIAL DEMAND...

AERO BRAND STEARATES

CALCIUM ... ZINC ... ALUMINUM ... MAGNESIUM

CYANAMID'S large-capacity, rigidly controlled manufacturing facilities offer exceptional advantages as your source of supply. Thorough inspection and meticulous control at each step from the acid to the final packaged product bearing the AERO* BRAND Seal make certain that your stearates will be fine and fluffy ... with clean, smooth dusting lube qualities ... and possessing the many other superior diversified processing characteristics inherent in each type. For product quality ... for service ... for all-around dependability ... it's CYANAMID AERO BRAND STEARATES.

CYANAMID'S MODERN FACILITIES BECOME YOUR DEPENDABLE SOURCE OF SUPPLY WHEN YOU SPECIFY...

AERO BRAND STEARATES

Industrial Chemicals Division

AMERICAN CYANAMID COMPANY

30 ROCKEFELLER PLAZA · NEW YORK 20, N. Y.

*Trade Mark

CABOT

STERLING S*

Three qualities distinguish Cabot's Sterling S. They are high resilience, high loading capacity, and low heat generation, both in carcass stocks and tubes.

Sterling S is Cabot's SRF* black in pelletized form. It is dustless, easy to handle.

Uniform quality of Sterling S is assured by the know-how of the world's largest producer of carbon black.

GODFREY L. CABOT, INC. 77 FRANKLIN ST. BOSTON 10, MASS.

Look to Pequanoc

FOR THE NEWEST in RUBBER RECLAIMS

A FEW OF OUR OTHER STANDARDS

- Alba
- Aurora
- Champion
- Eclipse
- Imperial
- Moccasin
- Mustang
- Neutrex
- Planet
- Red Star
- Ruby
- Tomahawk

Send for full data concerning these named reclaims for specific applications.

No. 3600

This synthetic tire reclaim is particularly advantageous in processing. It gives smoother tubing, fine calendering.

Reg. U. S. Pat. Off.

Write for sample, complete specifications, and price list.

PEQUANOC RUBBER CO.

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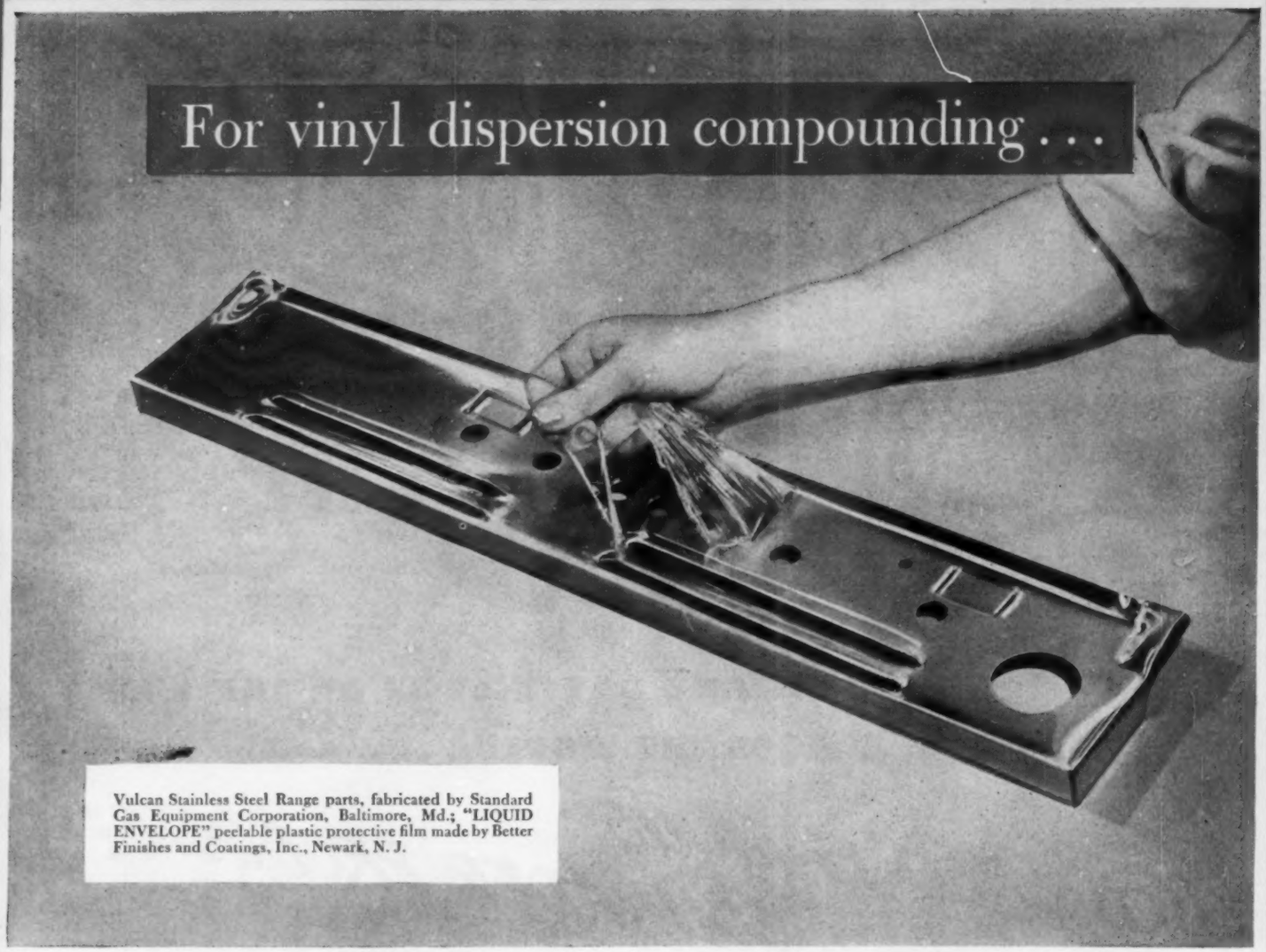

Vulcan Stainless Steel Range parts, fabricated by Standard Gas Equipment Corporation, Baltimore, Md.; "LIQUID ENVELOPE" peelable plastic protective film made by Better Finishes and Coatings, Inc., Newark, N. J.

MONOPLEX 16 gives low volatility and low water extraction, *plus* low cost

Whether you are making strip coats, coated fabrics, or molded vinyl compounds, you'll want to learn more about MONOPLEX 16. For this new, high molecular weight, monomeric, nitrile-type plasticizer is especially well suited for dispersion compounding of vinyls. Just blend MONOPLEX 16 and vinyl powder, spread in paste form on fabric or in mold, and flux at normal temperatures.

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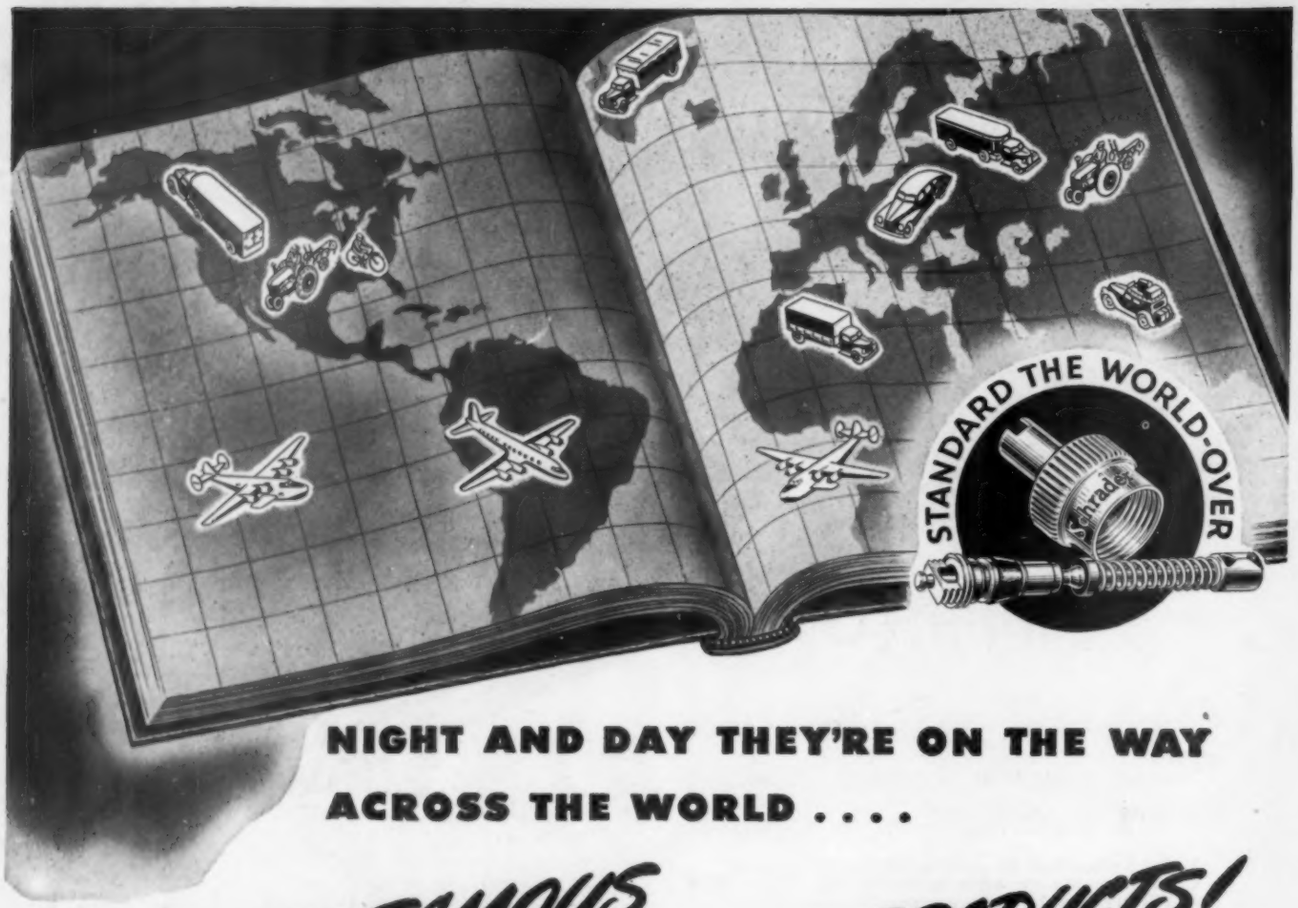

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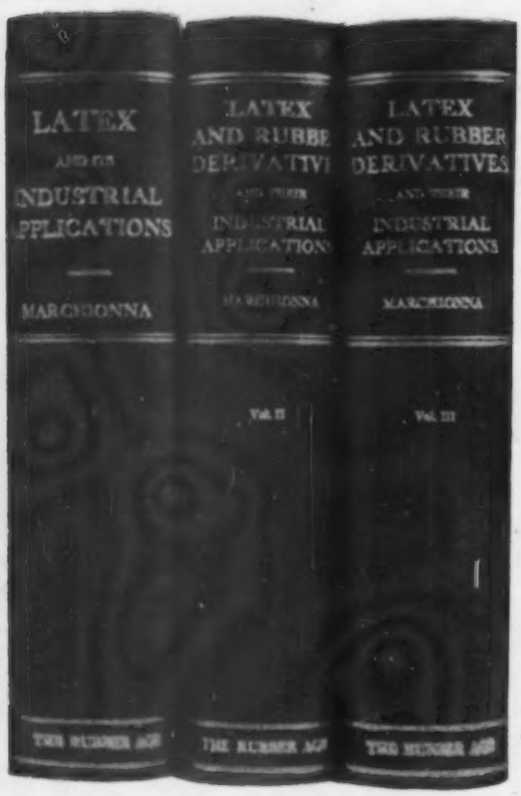

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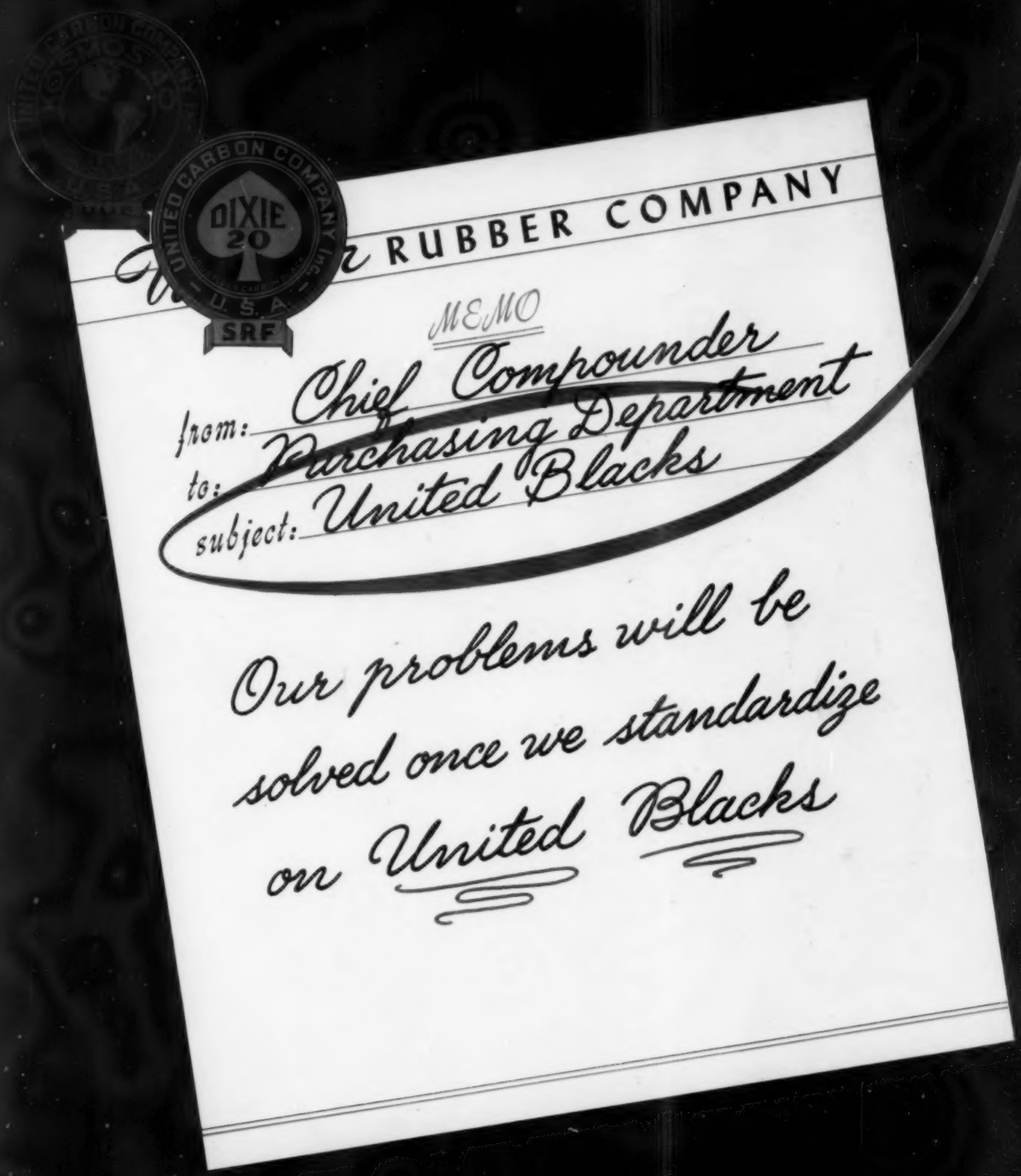

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A COMPARISON OF ANTIOXIDANTS in a Natural Rubber Tread Type Recipe

	Compound No. 1915 A	Compound No. 1915 B	Compound No. 1915 C
No. 1 Smoked Sheet	100	100	100
EPC Black	50	50	50
Zinc Oxide	5	5	5
Sulfur	3	3	3
El-Sixty	0.45	0.45	0.45
Santocure	0.30	0.30	0.30
Resinex L-4	2	2	2
Stearic Acid	3	3	3
Phenyl-beta-Naphthylamine	...	...	1
PDA-10	...	1	...

The test specimens were cured at 287° and tested at RT before and after ageing 96 hours, Oxygen Bomb at 70° C–300 lbs.

UNAGED

	Time of Cure	Modulus at 300%	Ult. Tensile	Ult. Elong.
Compound No. 1915 A (Control)	30 min.	1200	3700	603
	40 min.	1330	3770	580
	60 min.	1540	3930	563
Compound No. 1915 B (1% PDA-10)	30 min.	1120	3840	623
	40 min.	1300	4150	620
	60 min.	1490	4210	610
Compound No. 1915 C (1% PBNA)	30 min.	1090	3690	620
	40 min.	1310	4030	613
	60 min.	1400	3980	607

AGED

Compound No. 1915 A (Control)	30 min.	730	660	287
	40 min.	....	500	200
	60 min.	....	550	210
Compound No. 1915 B (1% PDA-10)	30 min.	1200	2070	480
	40 min.	1360	2240	470
	60 min.	1490	2090	430
Compound No. 1915 C (1% PBNA)	30 min.	1110	1830	463
	40 min.	1270	1970	453
	60 min.	1350	1930	423

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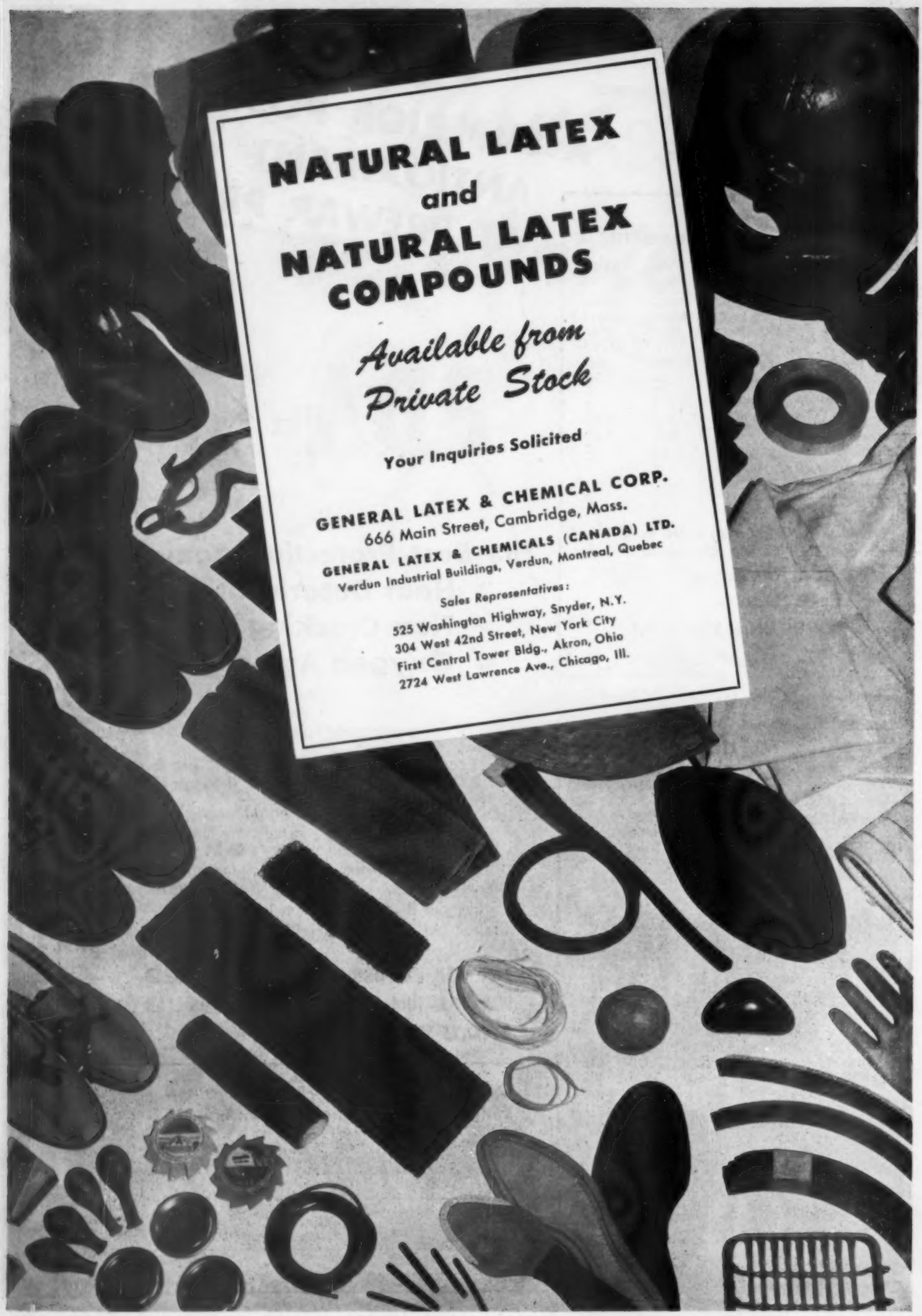
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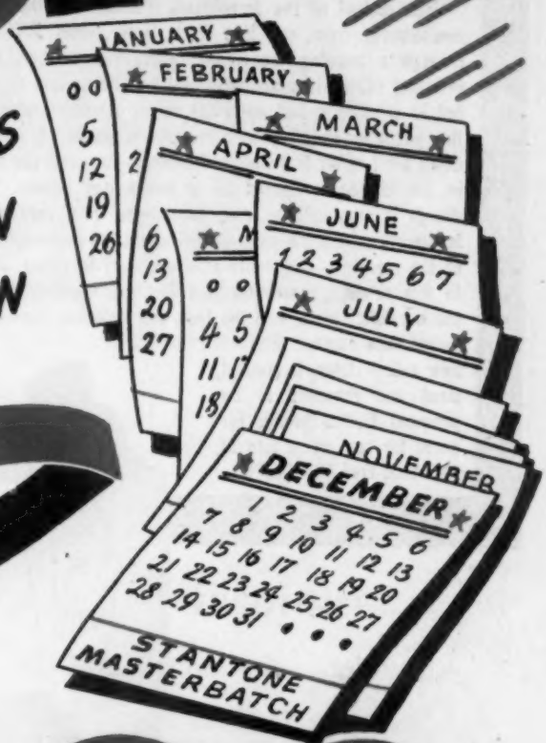

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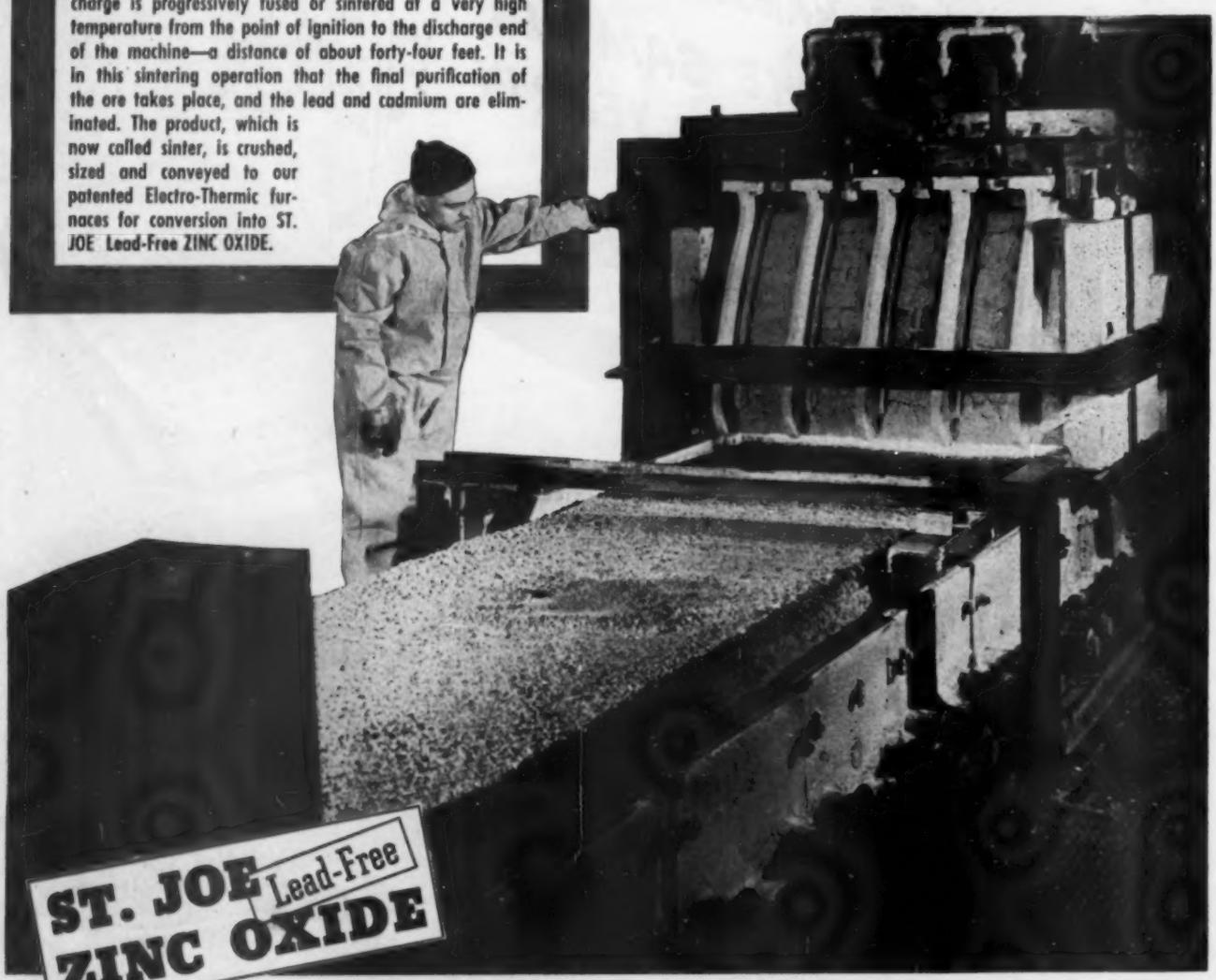
One of the 42″ x 44″ Dwight-Lloyd gas-fired sintering machines in operation at our Josephtown, Pa. smelter.



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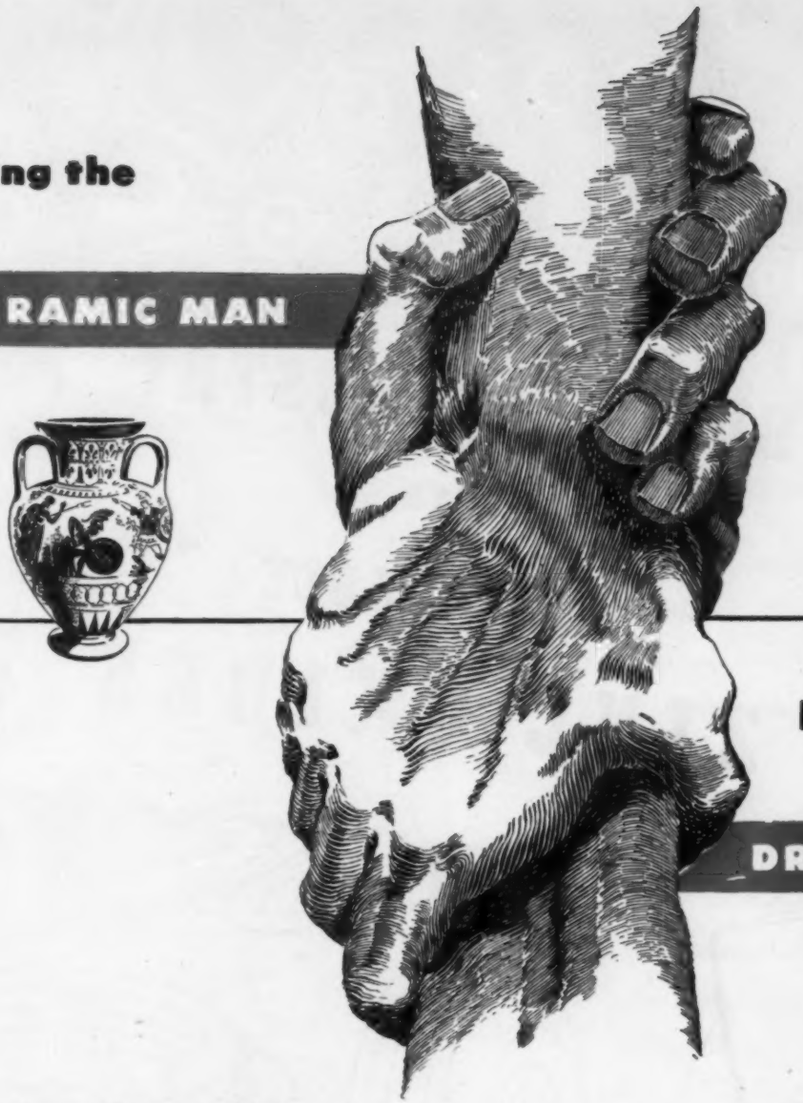

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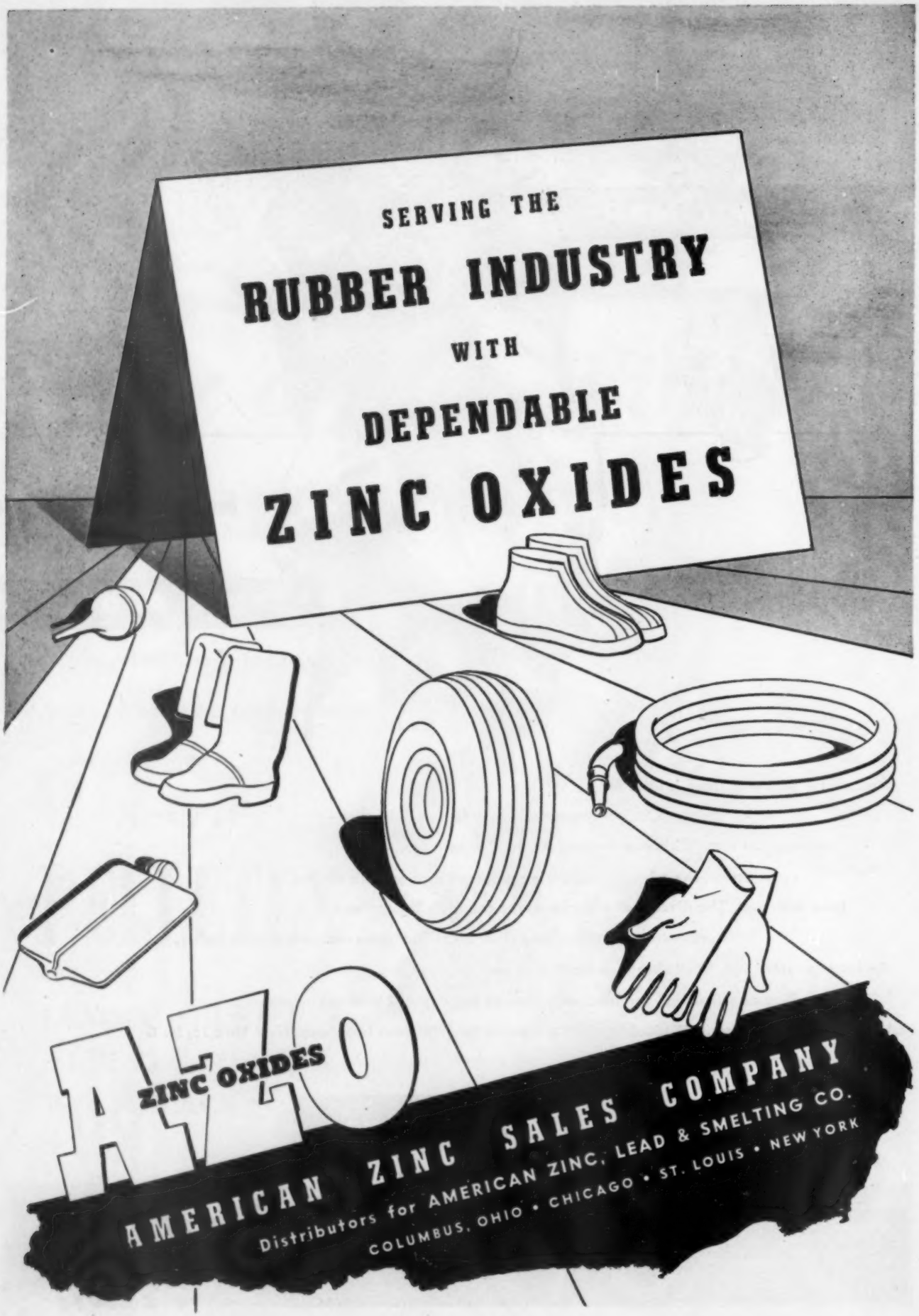
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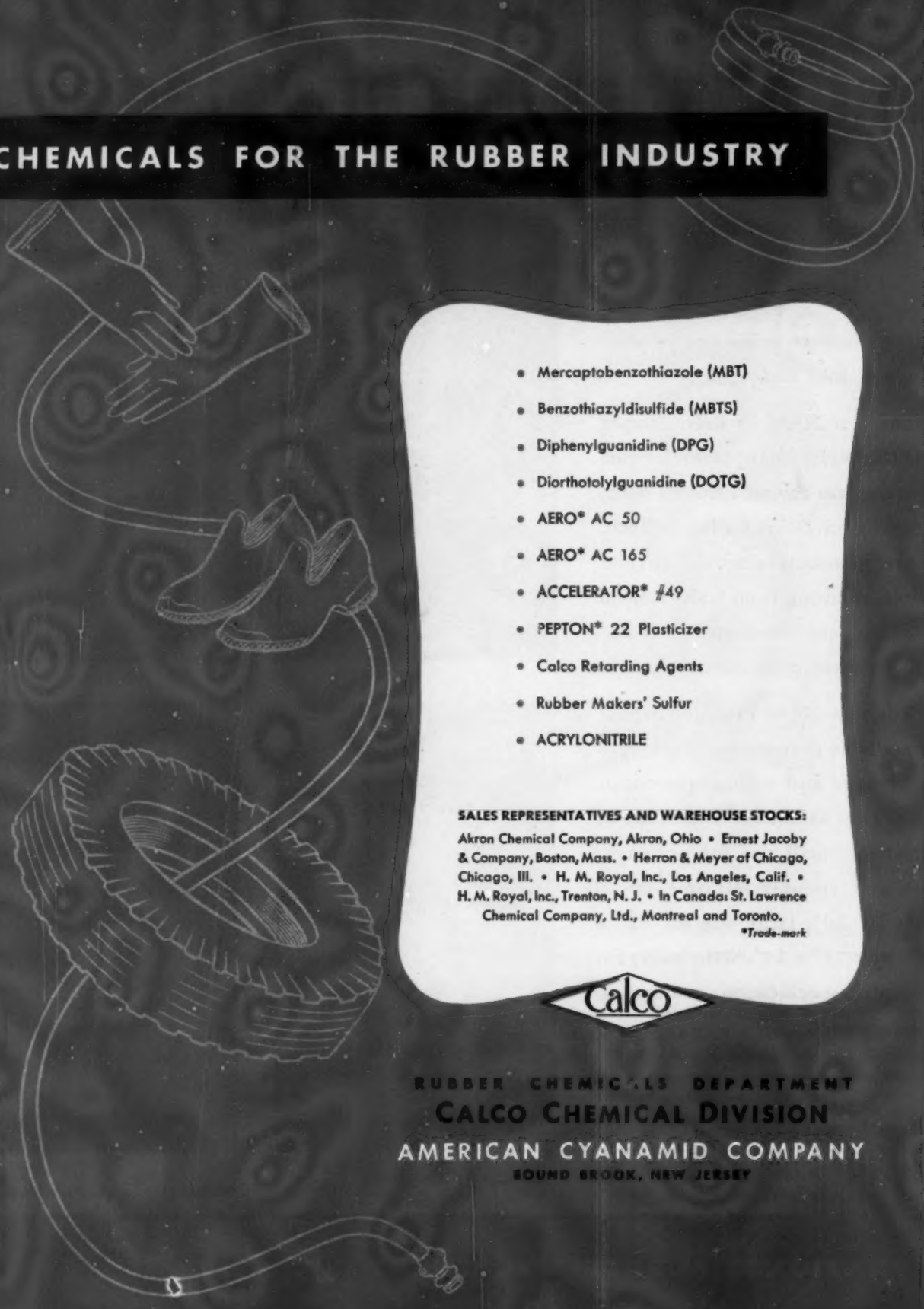

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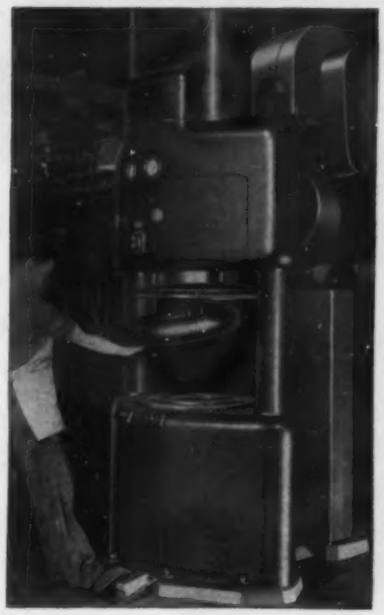

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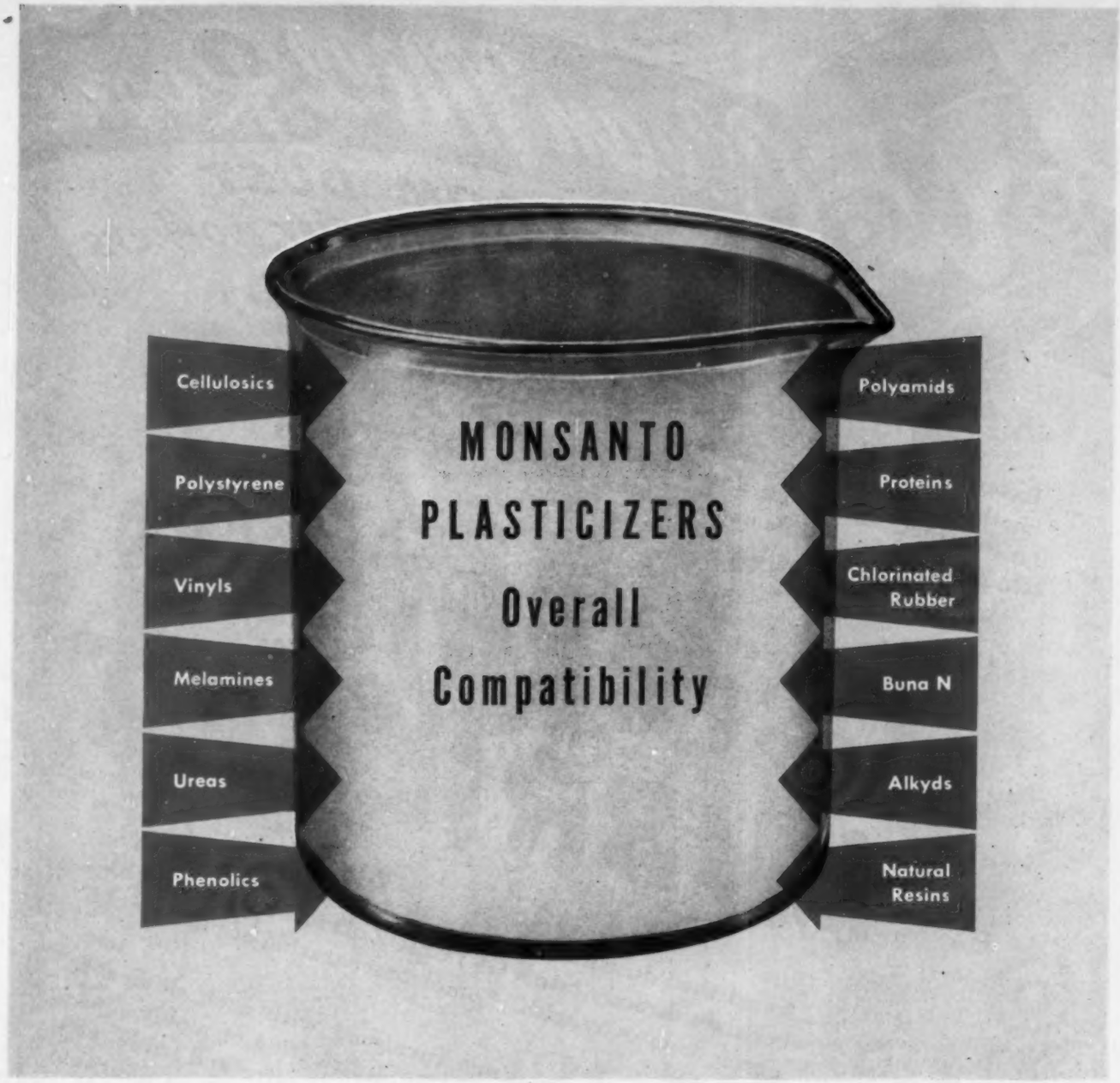

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☐ 13-4—Tire Carcass Compounds ☐ 13-5—Footwear & Heel Compounds

☐ 13-6—Camel Back ☐ 13-7—Motor Mount & Bumper Compounds

☐ 13-8—Wire Jacket and other Extruded Compounds ☐ 13-9—GR-S Packing Compounds

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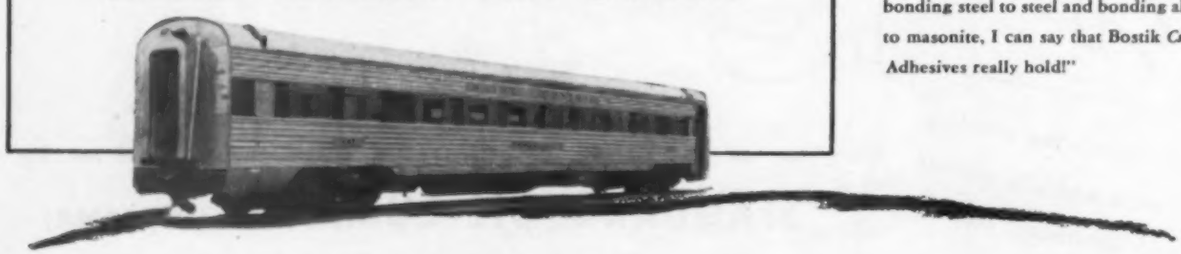

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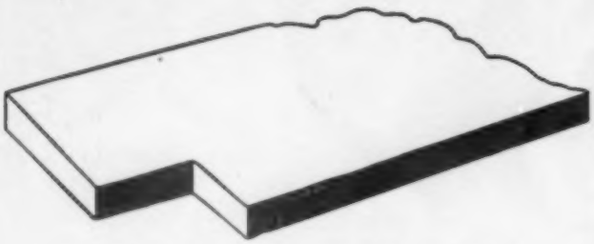

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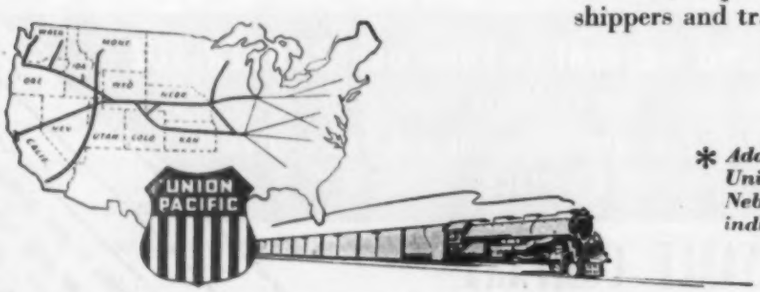

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Technical Bulletin No. 36 — on the Compounding of GR-S with Substantial Loadings of ZINC OXIDE

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The *Office of Rubber Reserve* defines these polymers as follows:

X-353: *"Activated GR-S polymerized at lower temperature to lower conversion, 50 Mooney. Lower temperature necessary for an activated recipe during polymerization and lower conversion generally favor processing. This polymer will be used as a control for X-354 in tire treads."*

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E.L.C. Magnesia	5.0
ZINC OXIDE	100.0

ORIGINAL RESULTS

Time of Cure Min. at 45 Lb.	Tensile Strength (psi)	Per Cent Elongation	Modulus Load (psi) for Elongation of: 200%	300%	400%	500%	Permanent Set	Shore Hardness	Tear Resistance Tested at: Room Temp.	100°C.
GR-S—X-353										
4	1850	730	205	290	410	660	.30	49	—	—
7.5	1830	645	255	340	555	890	.29	50	63	42
15	1540	590	270	385	575	960	.24	51	67	37
30	1320	525	310	465	700	1165	.20	52	63	39
45	1520	570	305	420	610	1030	.23	53	60	40
60	1670	580	270	425	620	1050	.23	53	63	35
90	1040	505	270	425	615	1000	.16	53	64	35
GR-S—X-354										
4	2120	610	315	590	900	1410	.22	50	—	—
7.5	1900	510	355	715	1070	1740	.19	52	66	37
15	2000	490	460	770	1270	—	.21	55	74	37
30	1715	445	455	800	1330	—	.17	56	71	35
45	1820	470	395	715	1270	—	.18	56	65	34
60	1865	480	425	740	1200	—	.18	56	69	35
90	1580	435	460	810	1345	—	.16	56	72	38

Time of Cure Min. at 45 Lb.	Goodyear-Healey Pendulum: Indentation in mm.	Per Cent Rebound	Hardness: Shore	Rex	Compression Fatigue (Goodrich Flexometer)*: Per Cent Initial Comp.	Running Time and Per Cent Permanent Set	Max. Temp. Rise °C.	Dynamic Compression: Initial	Final	Cut-Growth Resistance Tested at 70° C. Inches Failure 1900 Cycles	Mooney Plasticity After 1½ Min.
GR-S—X-353											
60	7.75	66.0	52	55	24.2	17'-7.5	27.3 (At 15'-27.3)	14.8	20.5	.91	54
GR-S—X-354											
60	7.47	69.3	56	59	23.0	15'-4.6	22.8	13.0	15.0	1.0	84

* Test Conditions: 143 Lb. Load. 0.175" Stroke. 100° C. Oven Temp.

X-353 gives somewhat better results generally than Standard GR-S with high Zinc Oxide loadings. With X-354 higher stress-strain values are realized, as is the usual experience with high Mooney polymers. Tear resistance, pendulum rebound and heat generation are better. The cut-growth is on the low side, probably on account of the fact that the cure selected was on the "over"-side.

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The RUBBER AGE

VOLUME 61
NUMBER 6

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RUBBER AGE

Vol. 61, No. 6 SEPTEMBER, 1947

Comparison of the Carrying Capacities of Rough and Smooth Bore Oil Suction and Discharge Hose Under Simulative Service Conditions

By THEODORE A. WERKENTHIN*, ROBERT R. JAMES**, and ROSS E. MORRIS†

NEW techniques of fueling of Naval vessels while underway in heavy seas involved modifications in gear used, including the hose. The work of Dr. W. S. Pardos *(1)* of the Civil Engineering Department of the University of Pennsylvania, published by E. I. du Pont de Nemours & Co. in 1939, had generally been accepted by the rubber industry and by the concerns handling all types of petroleum products. These operations included all shore pumping operations, oil transfers, as well as dock-to-barge, tanker-to-ship and ship-to-ship transfer operations.

The Bureau of Construction and Repair, the predecessor of the Bureau of Ships, also accepted these data, and smooth bore hose of various constructions was procured under Bureau of Ships Ad Interim Specifications 33H17, 33H20, 33H21 and 33H23.

To further show the importance of the work of Pardos, it might be mentioned that the Bureau of Yards and Docks and the Bureau of Supplies and Accounts Navy handbook of operating procedures for handling fuel oil and Diesel oil *(2)* contained many calculations which were based on the data furnished by Pardos.

The whole question of relative throughput of fuel oil, gasoline and Diesel oil through rough bore and smooth bore hose was reopened when the rubber manufacturers informed the Bureau of Ships, at the beginning of World War II, that rough bore hose could be manufactured much more readily than smooth bore hose in the very large quantities required for the war effort. In order to justify the requirement for smooth bore hose for fueling-at-sea, one had to have conclusive data, derived from official Navy tests. A careful survey of all existing literature was made by Mrs. Mattie Houghten, of the Bureau of Ships Technical Library, in order to determine whether conclusive evidence could be presented to justify the use of smooth bore hose, in spite of greater manufacturing difficulties.

Extensive tests had been conducted by Beck and Miller on various fuel oil systems similar to those used on board ship. For example, they discussed the pressure losses in marine fuel oil systems *(3)*. Also discussed were the laminar flow friction losses through fittings, bends and valves *(4)*. This was further amplified in a discussion of the pressure losses in 90° constant circular cross-section bends and in valves and fittings *(5, 6)*.

The Hydraulic Institute in June, 1941 *(7)*, revised their Standards of the Hydraulic Institute, Section G, which had originally been published in 1937. In this

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Note: The opinions or assertions contained herein are the private ones of the authors and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

compendium are given comprehensive tables and charts on the friction losses through various types of pipes.

Bakhmeteff and Allan presented a paper in 1945 on "The Mechanism of Energy Loss in Fluids Friction" *(8)*. The effect of wall roughness on flow is discussed at length on pages 147 to 155 of this article, but the article does not present a method for accurately calculating flow rates and pressure drops for conditions exactly simulating flow of oil through rough and smooth bore hose. Dodge and Thompson *(9)* discussed the roughness effect on flow of fluids in pipes as did Schroeder and Dawson *(10)* and Jameson *(11)* in their books on fluid mechanics. A review of other books discussing these problems, such as the work of Moody *(12)*, Kalinske *(13, 14)* Colebrook *(15)*, Beij *(16)*, as well as Boelter and Kepner *(17)* and Buthod and Whiteley *(18)*, confirmed our previous findings that approximations of the relative flow through rough and smooth bore hose could be made, and, for many purposes, would be entirely satisfactory. However, the importance of transferring the maximum quantity of oil from tanker to Naval vessel or from one Naval vessel to another during combat operations was so critical that estimations and calculations had to be confirmed by actual simulative pumping tests.

Other works on hydro-mechanics which were consulted in this matter included Pigott's work *(19)* on "Flow of Fluids in Closed Conduits" and Genereaux's article *(20)* utilizing alignment charts for quick graphic solution of flow of fluid problems. Kemler, in his article on "The Study of the Data on the Flow of Fluids in Pipes" *(21)*, discussed the effect of artificially roughened pipes on the flow of fluids. Many of these articles were extremely helpful in a complete review of this problem. Among these was Daugherty's work *(22)* because, besides water, his experiments included other fluids, particularly crude oil, lubricating oil, kerosene, gasoline, and various aqueous solutions.

It was found that considerable confusion existed in the interpretation of roughness and smoothness. For example, O'Brien, Folsom and Jonassen *(23)* discussed the problems of defining smoothness and roughness and showed that the same pipe may be "smooth" under one set of conditions and "rough" under another set of conditions. However, the degree of roughness mentioned in this pipe is of an entirely different order of magnitude from that found in rough and smooth bore oil hose.

In order to have incontrovertible evidence, it was necessary to conduct actual tests using diesel oil and fuel oil in lieu of water as a pumping medium. This would eliminate one of the main variables, namely, that of converting the data derived in pumping tests utilizing water to equivalent data on pumping of various types of oils. As time was of the essence, tests were authorized to be conducted simultaneously under the cognizance of the Rubber Laboratory at Mare Island, California, and under the cognizance of the Naval Boiler & Turbine Laboratory at the Naval Supply Depot, Cheatham Annex, Norfolk, Va. This article will deal entirely with the results obtained in the tests at Mare Island. A second article will be presented discussing in detail the results obtained at Cheatham Annex. However, there will be no duplication in these articles as the present article is intended to be presented primarily from the standpoint of the rubber hose manufacturer and for fueling-at-sea pumping operations, whereas the other article will present the data primarily from the standpoint of the petroleum engineers responsible for transfer of various grades of petroleum oils of all types. This second article will be written by Mr. N. E. Kauffman of the Naval Boiler & Turbine Laboratory and co-authors.

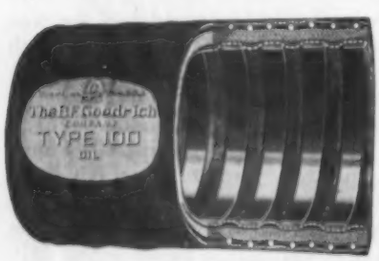


FIG. 1 — Cut-away view of rough bore hose.

FIG. 2 — Cut-away view of smooth bore hose.

Distinction Between Types of Hose

Prior to the discovery of oil-resistant synthetic rubbers, it was customary to manufacture oil hose with an inner helix of flat steel wire as well as the usual imbedded helix of round or flat wire. Most of the alternate layers of vulcanized natural rubber and square woven fabric in the wall of the hose were enclosed between these helices. The concentric wire helices prevented the hose from going to pieces when the natural rubber layers were swollen and weakened by the oil diffusing into them. This type of hose is known as rough bore because of the interior corrugations caused by the flat wire helix. A cut-away view of rough bore hose is shown in Figure 1.

With the advent of oil-resistant synthetic rubbers it became possible to manufacture hose without an inner wire helix. It was no longer necessary to clamp the alternate fabric and rubber layers between wire helices since the synthetic rubber layers maintain their strength in the presence of oil. The interior surface of the new hose is as smooth as the mandrel upon which it is built; consequently this hose is termed smooth bore. A cut-away view of smooth bore oil hose is presented in Figure 2.

The years since the first oil-resistant synthetic rubber became available have not seen the disappearance of rough bore oil hose from the market. Rough bore hose offers two advantages to the buyer: it is somewhat more resistant to crushing and kinking than smooth bore hose, and it cannot lose its liner or tube as sometimes occurs in the latter hose. Some unfortunate experiences with smooth bore water hose in which the liner became detached from the carcass of the hose, resulting in fouling of the pump suction, were probably responsible for much of the unfavorable reception which smooth bore hose received from some sources. Actually, this hose was constructed from low grade reclaimed rubber stocks having low ply adhesion, and

has no resemblance to the high quality oil-resisting hose procured under Navy Department Specifications 33H17, 33H21 and 33H23.

Rough bore hose offers an advantage to the manufacturer; he can use a lower grade stock from the standpoint of physical strength for the impermeable layer because this layer is protected from the abrasive action of the hose contents by the inner wire helix and a ply of fabric.

It seems self-evident from the appearance of the hose interiors that smooth bore hose will carry more oil than rough bore hose at the same pumping pressure. The corrugations on the inner surface of the rough bore hose would be expected to hinder the flow of fluid by causing excessive turbulence and therefore a greater pressure loss per unit length of hose. As previously discussed, Pardos confirmed this expectation. However, his tests were conducted on 6-inch rough bore hose, 6-inch smooth bore hose and 8-inch rough bore hose. Pardos' tests were made on single 25 foot sections of hose and utilized water throughout as the fluid of test. The relationships between Reynolds' number and friction factor which were established by Pardos for 6-inch and 8-inch hose may be used to calculate the flow rates of oils of known viscosity in long lengths of hose of the same size.

The purpose of the work described herein was to obtain actual experimental data on relative flow rates of oil in smooth bore and rough bore hose of the 4-inch and 6-inch sizes, using for these measurements not less than 150 feet of hose. This work was done in the tank farm of the Tide Water Associated Oil Company, at Avon, California.

The 4-inch rough bore and smooth bore hose and the 6-inch rough bore and smooth bore hose were of standard manufacture complying with Navy specifications *(24, 25)*. The nominal length of the 4-inch hose sections was 25 feet; that of the 6-inch hose sections was 20 feet. All of the hose sections except the 4-inch smooth bore were fitted with flanged nipples; the latter sections were fitted with swivel connection couplings. Plaster casts of the interior of these hoses are depicted in Figures 3, 4, 5, and 6. The majority of the pumping tests were performed with fuel oil, but a few tests on the 4-inch size only were performed with diesel oil. The oils complied with the then applicable Navy specifications *(26, 27)*.

Arrangement for Testing

Separate pumping tests were conducted with the hose in an approximately horizontal position and in a draped position. The 4-inch hose in the horizontal position during the tests with diesel oil are shown in Figure 7. The 6-inch hose in the draped position during the tests with fuel oil are shown in Figure 8. The draped hose was to simulate some methods of fueling at sea in which the hoses are suspended in bight saddles and suspended in loops which change the angle of deflection at will with a relative motion of the ships undergoing fueling operations. The rough bore and smooth bore hose were laid side by side and were connected through gate valves to Y fittings at the inlet and outlet ends as shown in Figures 7, 9, and 10. This arrangement made it possible to switch the flow of oil rapidly from the rough bore to the smooth bore, and vice versa.

It will be noted in Figure 10 that an additional flanged nipple was inserted between the end of one hose and its gate valve at the outlet end. This was

FIG. 3—Plaster cast of 4-inch smooth bore hose after flow tests.

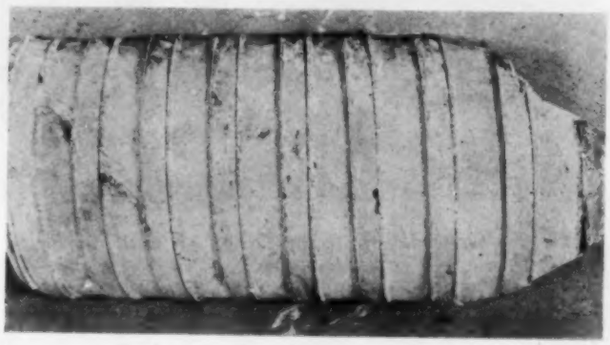


FIG. 4—Plaster cast of 4-inch rough bore hose after flow tests.

FIG. 5—Plaster cast of 6-inch smooth bore hose after flow tests.

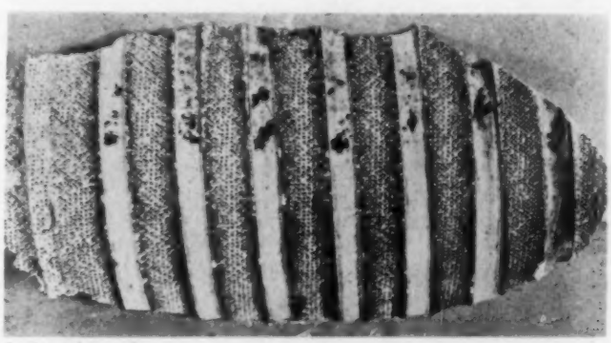


FIG. 6—Plaster cast of 6-inch rough bore hose after flow tests.

FIG. 7—General layout for Diesel oil pumping tests on 4-inch hose.

FIG. 8—Six-inch hose supported on "A" frame in fuel oil pumping tests (inlet end).

done in an attempt to equalize the lengths between the Y fittings, since the hose increased in length while under pressure and the smooth bore hose increased in length more than the rough bore. The lengths were equalized in this manner for every test except the diesel oil tests. In the latter tests, it was convenient to connect only one hose at a time to the outlet Y fitting, so that it was not necessary to equalize the lengths.

When pressure was applied to the hose, they tended to "snake." Nothing was done about this when testing the hose in the draped position. However, when testing the hose in the horizontal position, an attempt was made to straighten the hose while under pressure, by pulling with a chain block connected between the inlet Y fitting and a large pipe riser in line with, and several yards beyond, the ends of the hose. It was not possible to obtain straight hose in any of the tests, but the gradual curves left in the hose probably had little, if any, effect on the rate of oil flow.

The inlet ends of the hose were 1.8 feet higher than the outlet ends during the fuel oil tests, and were 0.6 feet higher than the outlet ends during the diesel oil tests. The static pressure heads created by these height differences were ignored in the calculations because they amounted to less than ½ pound per square inch pressure, and therefore were within the tolerance of the measurements.

The hose during all tests in the horizontal position were supported by crosswise timbers spaced 3 to 4 feet apart. The crosswise timbers in turn were supported by two large pipes running parallel to the hose. Six lengths of each type of 4-inch hose, nominal length 150 feet, and eight lengths of each type of 6-inch hose, nominal length 160 feet, were used.

The hose in the draped position were supported by the crosswise timbers except at two points in their length, where they were held about 14 feet above the common level by saddles attached to the cross bars of A frames. This is shown in Figure 8. The respective centers of elevation were approximately 20 feet from the closest end of the hose. This arrangement simulated hose being supported by dockside or shipboard derricks.

The pressures at the inlet and outlet ends of the hose were obtained with the piezometer rings as shown in Figures 9 and 10. These rings were inserted between the end flanges of the hose and the adjacent flanged nipples. Each ring had four ⅛-inch openings, which were connected by a common tubing lead to the calibrated pressure gauges shown in Figures 11 and 12. By means of an arrangement of valves, the gauges could be connected to the piezometer rings on either hose. The gauges had a range of 250 pounds per square inch and were graduated in 5-pound units. The readings were estimated to the closest ½ pound. The temperature of the oil in the hose was read on the thermometers inserted in the inlet nipples. These thermometers may be seen in Figure 9.

The rate of flow of the oil was recorded by a Foxboro flowmeter, which was designed to operate on differential pressures up to 100 inches of water. This flowmeter is illustrated in Figure 13. The differential pressures were created by a square-edged circular orifice plate in the line. The diameter of the circular orifice depended upon the size of the pipe and the velocity range being covered. The thickness of the orifice plate was either ⅛ inch (for 6-inch pipe) or ¼ inch (for 12-inch pipe).

For the measurements of flow rates in the fuel oil tests, the orifice plates were installed between special flanges in a standard 12-inch pipe upstream from the hose. This installation may be seen in Figure 13. The flowmeter was connected to the 12-inch pipe on either side of the orifice plate by single ⅛-inch holes drilled in each flange. The centers of these holes were one inch upstream and downstream, respectively, from the center plane of the orifice plate. The 12-inch pipe was

straight and free from joints for more than 50 feet upstream from the orifice plate and for 30 feet downstream.

For the measurements of flow rates in the diesel oil tests, the orifice plates were installed between special flanges in a standard 6-inch pipe downstream from the hose. This installation may be seen in Figure 12. The location and size of the connections between the flowmeter and the 6-inch pipe were the same as those described for the 12-inch pipe. The 6-inch pipe was straight and free from joints for 80 feet in either direction from the orifice.

The accuracy of the flow rate calculated from the flowmeter recording was checked by direct measurement of the volume of oil pumped through an orifice in the 12-inch line at constant pressure in a known time interval. The calculated value was found to differ by 0.5 per cent from the true value. This accuracy was believed to be satisfactory, particularly in view of the fact the measurements were made primarily to obtain comparative ratings for the two types of hose.

Procedure for Testing with Fuel Oil

The fuel oil was circulated by a centrifugal pump from a 55,000-barrel tank, through the hose, and back into the tank. The gate valve on the inlet end of the hose to be tested was opened full; the gate valve on the inlet end of the other hose was closed. The gate valves at the outlet ends of both hose were opened full. Tests were made with the pressure at the inlet end held constant at 50, 110 or 150 p.s.i. The flow rate was regulated to any desired value by adjusting the valve opening, and thereby the pressure at the outlet end; the higher the outlet pressure, the lower the flow rate.

The pressure adjustments were made by regulating gate valves upstream and downstream, respectively, from the Y fittings. Thus, excessive or irregular turbulence in the vicinity of the piezometer rings was avoided.

The constant feature of every test run was the oil pressure at the inlet end of the hose. The intentionally variable feature was the pressure loss through the hose, i.e., the difference between the readings of the pressure gauges connected to the inlet and outlet piezometer rings, respectively. A change in the pressure loss in the hose resulted, of course, in a corresponding change in the flow rate of oil through the hose. In every test run, at least eight pressure losses of stepwise magnitude were established in turn and the corresponding flow rates were noted. It was possible to plot curves showing presure loss versus flow rate for these test runs when suitable corrections had been made for the length of the hose. These curves will be presented after giving further details of the testing procedure and describing the manner in which the corrections were made.

As pointed out previously, the lengths of the hose increased as the pressure increased, and the changes in length were not the same for the rough bore hose as for the smooth bore hose. These changes in length were largely reversible because most of the tendency for permanent set was eliminated during the preliminary experiments. In order to have a true comparison between the rough bore hose and the smooth bore hose, it was necessary to convert the measured pressure losses through the hose to some standard length. A length of 100 feet was selected. The conversion was made by multiplying the measured pressure loss by 100 and dividing by the length of the hose during the test.

The lengths of the hose were not actually measured during each test. Instead, the lengths were measured when the hose contained static oil at a low pressure or no pressure, and then again when the oil was being pumped through the hose at the highest pressure used. The lengths at intermediate pressures were determined

FIG. 9—Inlet connection on 6-inch hose in fuel oil pumping tests (hose horizontal).

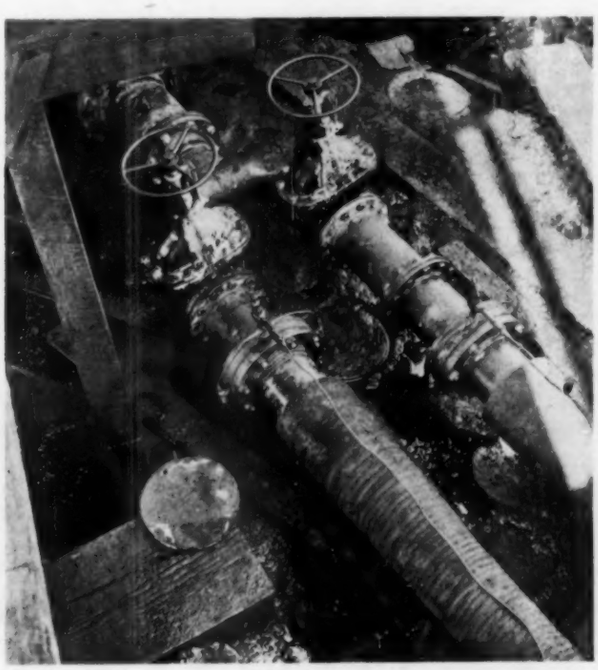


FIG. 10—Outlet connections on 6-inch hose in fuel oil pumping tests (hose horizontal).

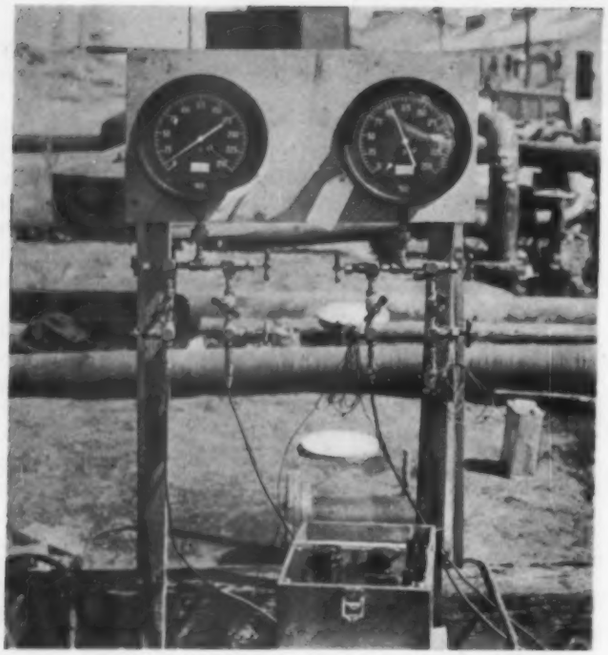


FIG. 11—Gage assembly used in fuel oil pumping tests.

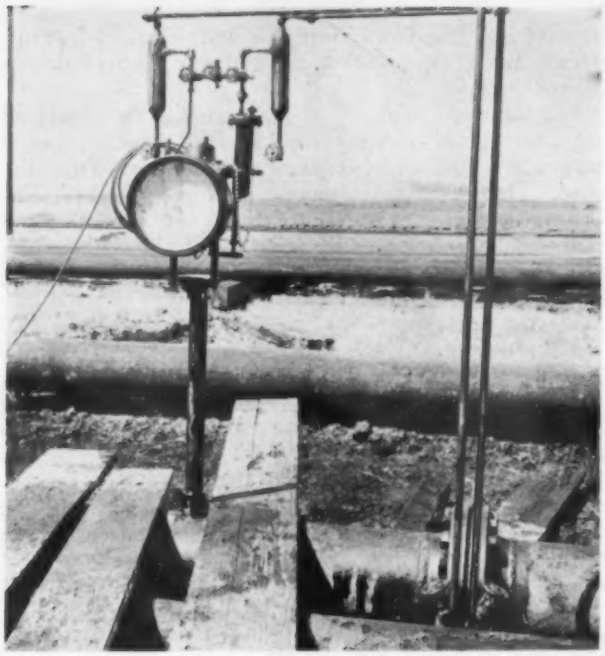


FIG. 13—Foxboro Flowmeter, designed to operate at differential pressures

by interpolation, assuming the length to be proportional to the pressure. The pressure data used for the interpolations were the values obtained by averaging the pressures measured at the inlet and outlet ends of the hose.

The oil in the tank was not at the same level nor at the same temperature during every test run because the tests could be conducted only as time permitted between ship loading and tank refilling. However, the tank level was constant and the temperature of the oil did not vary over a range of more than 7° F. during the series of comparative tests on one size rough bore and smooth bore hose in each position. The height of oil in the tank had no effect on the tests other than to produce a static pressure in the hose which varied from 1 to 12 pounds per square inch.

A sample of the oil was withdrawn after each test run. The viscosity of the oil was measured at the average temperature of the test run with a Brookfield viscosimeter. The density of the oil was determined at the temperature of the test run by means of a Westphal balance. The viscosity and density data were required for the calculation of Reynolds' numbers.

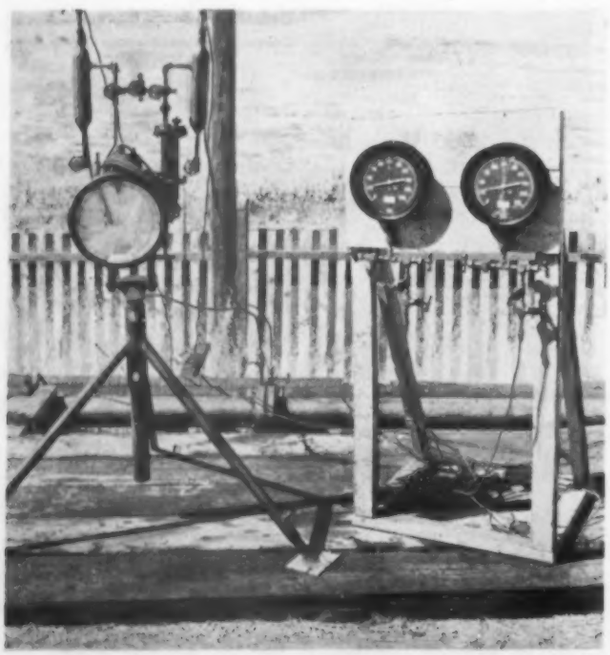


FIG. 12—Flowmeter and gage installation for Diesel oil pumping tests.

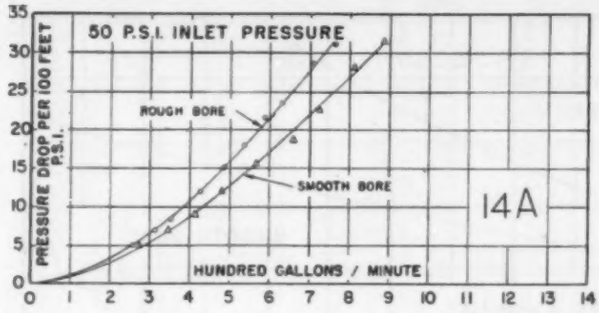
Procedure for Testing with Diesel Oil

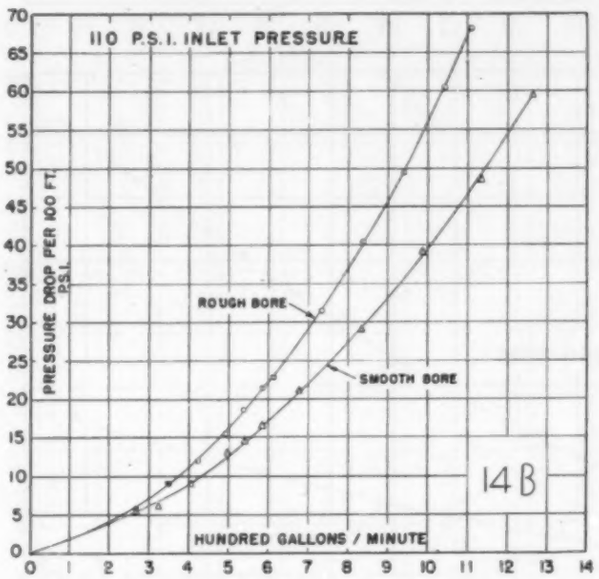
The diesel oil was drawn from a 55,000-barrel tank and pumped through the hose into another tank. Due to the difference in elevation of the tanks the static pressure in the hose amounted to about 30 pounds per square inch. This had no effect on the tests.

The testing procedure with diesel oil was the same as the testing procedure with fuel oil except that it was not as extensive. The centrifugal pump did not have sufficient capacity to test the 6-inch hose at the desired pressures, nor enough capacity to test the 4-inch hose above 110 pounds per square inch pressure. Even at the latter pressure it was only possible to obtain flow rates up to 450 gallons per minute.

Results of Fuel Oil Tests

The flow rates in gallons per minute of fuel oil are plotted against the pressure drops per 100 feet of hose for each of the experimental conditions listed below. The curves for the same size rough and smooth bore





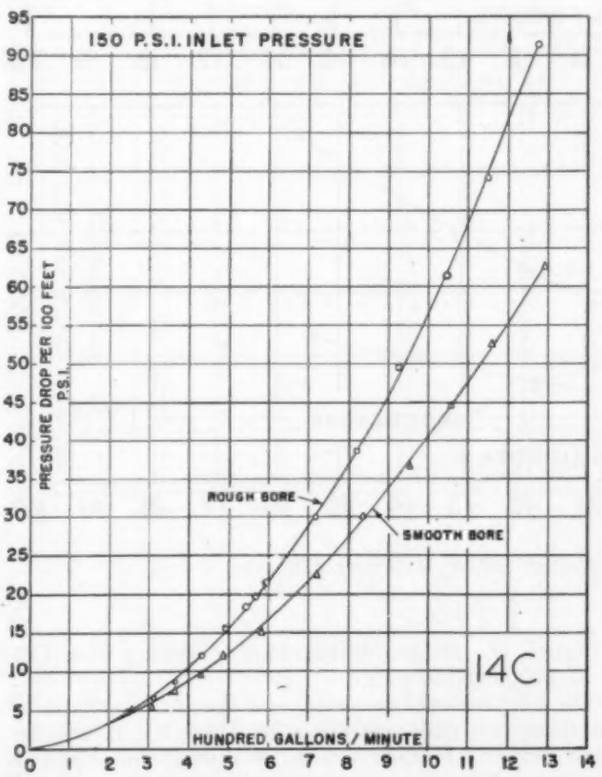
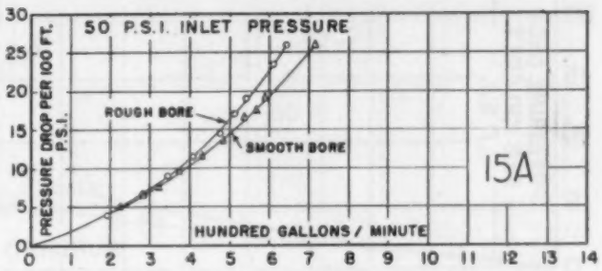
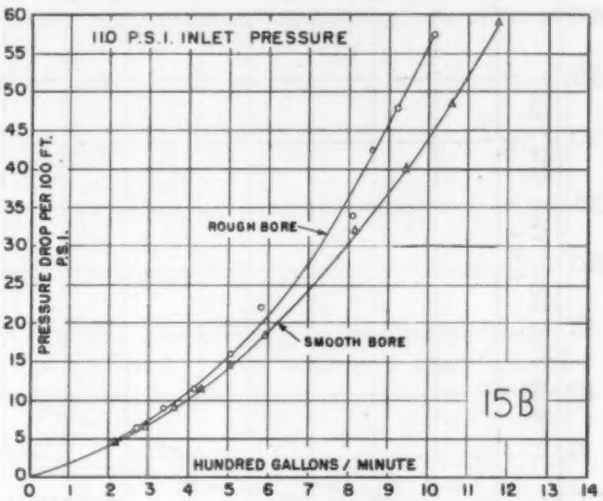


FIG. 14—Horizontal 4-inch hose carrying fuel oil at 50, 110 and 150 p.s.i.





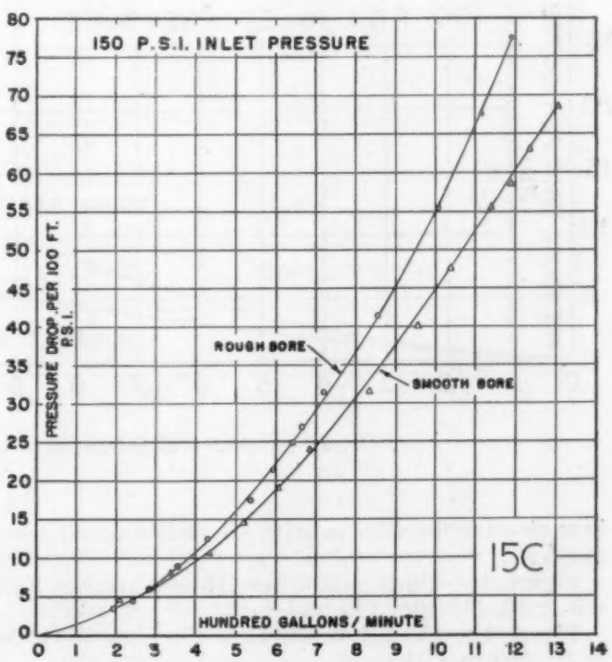


FIG. 15—Draped 4-inch hose carrying fuel oil at 50, 110 and 150 p.s.i.

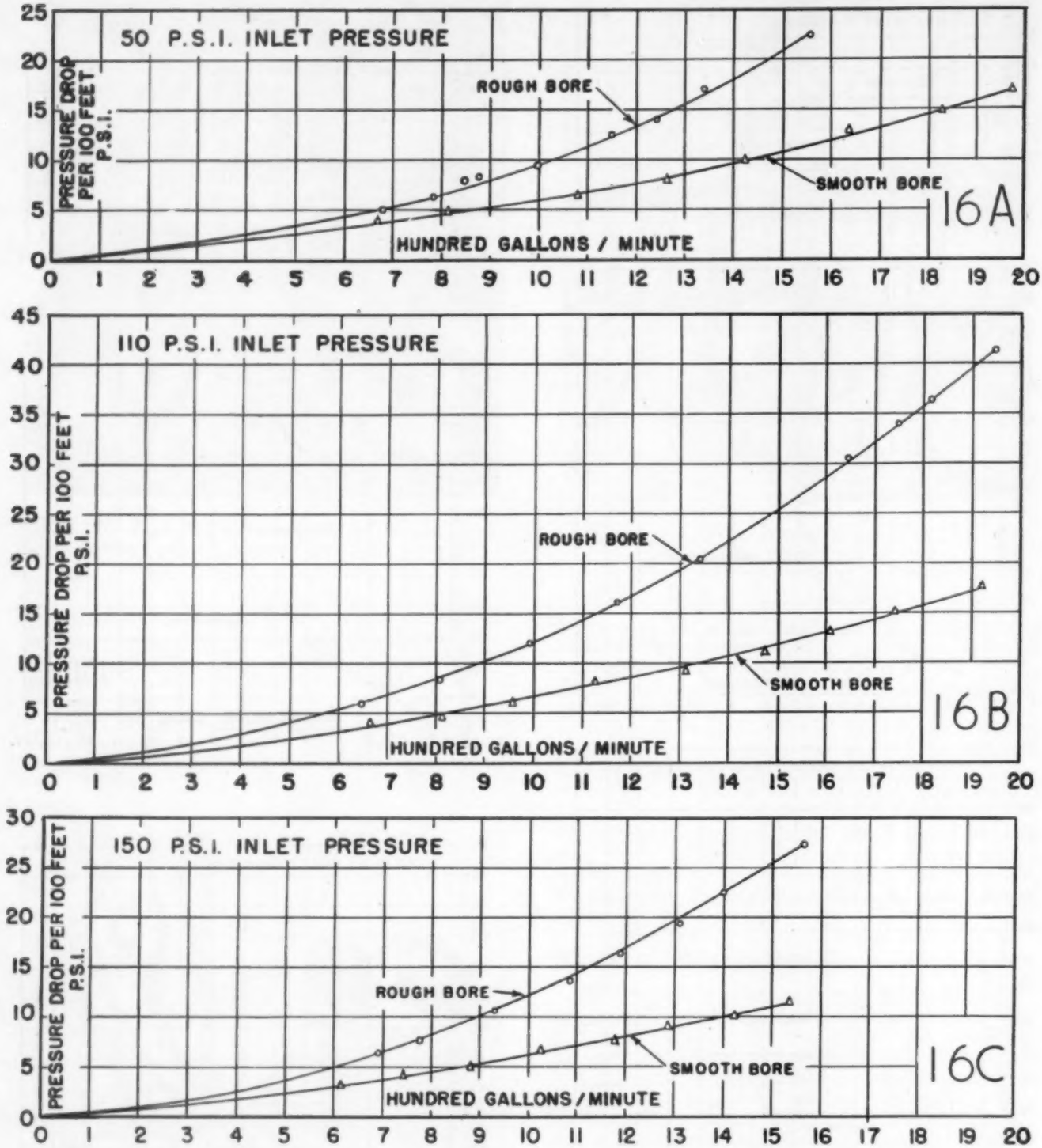


FIG. 16—Horizontal 6-inch hose carrying fuel oil at 50, 110 and 150 p.s.i.

hose tested in the same position are plotted on the same graph:

Figure 14—Horizontal 4-inch Hose Carrying Fuel Oil at 50, 110, and 150 p.s.i.

Figure 15—Draped 4-inch Hose Carrying Fuel Oil at 50, 110, and 150 p.s.i.

Figure 16—Horizontal 6-inch Hose Carrying Fuel Oil at 50, 110, and 150 p.s.i.

Figure 17—Draped 6-inch Hose Carrying Fuel Oil at 50, 110, and 150 p.s.i.

The temperature, viscosity, and specific gravity data for these test runs are given in Table I. It will be noted that the average viscosities during the pumping tests ranged from a low of 45 centipoises to a high of 86 centipoises. This variation, of course, was mainly due to the unavoidably different temperatures at which

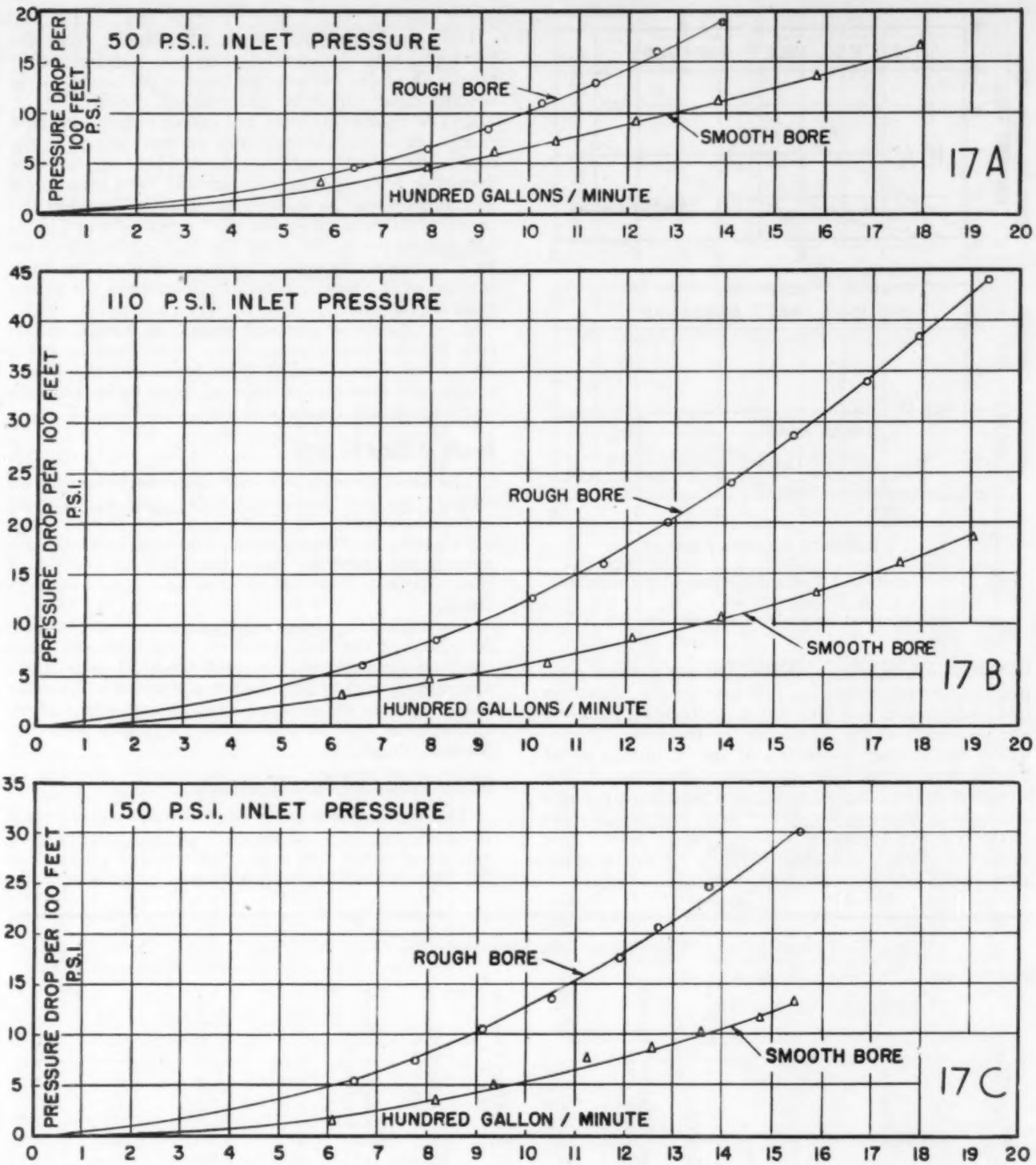


FIG. 17—Draped 6-inch hose carrying fuel oil at 50, 110 and 150 p.s.i.

the pumping tests were conducted.

The curves demonstrate clearly that the smooth bore hose carried more oil for the same pressure differential than the rough bore when the hose had the same internal diameter and laid in the same position. Furthermore, the curves show that the relative superiority of the smooth bore hose increased somewhat as the pressure differential increased. For example, Figure 14c shows that at a pressure drop of 15 pounds per square inch in 100 feet, the horizontal 4-inch smooth bore hose carried 16 per cent more oil than the horizontal 4-inch rough bore hose, whereas at a pressure drop of 60 pounds the smooth bore hose carried 22 per cent more oil than the rough bore hose. These observations are qualitatively in accord with those of Pardos.

A direct comparison between the individual curves

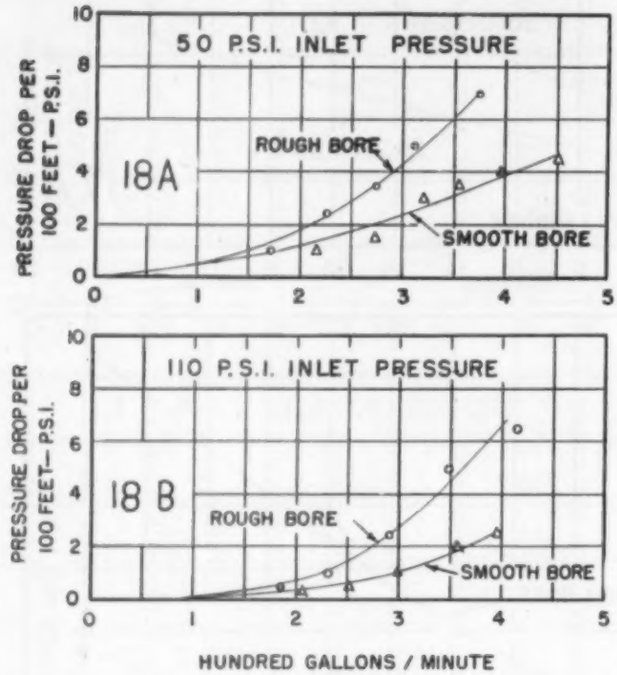


FIG. 18—Horizontal 4-inch hose carrying Diesel oil at 50 and 110 p.s.i.

on the same graph is justifiable, but not a direct comparison between curves on different graphs, except in cases where there was little difference between the average viscosities of the oil during the test runs. Fortunately, the average viscosities of the oil during all of the test runs except those involving 4-inch draped hose were within the range 45 to 56, thus permitting a rough comparison between the 4-inch hose and 6-inch hose in the horizontal position and between the 6-inch hose in the horizontal and draped positions. These comparisons lead to the following conclusions:

1. In most cases for the same pressure drop, the horizontal hose carried a little more oil than the draped hose. This is to be expected because the bends due to draping cause additional turbulence in the oil.

2. The relation between the pressure drop and flow rate is not dependent upon inlet pressure except in the case of the 6-inch rough bore hose. This hose, whether draped or horizontal, carried more oil for a given pressure drop when the inlet pressure was 50 pounds per square inch than when the inlet pressure was 110 or 150 pounds per square inch. The higher pressures may have increased the depth of corrugations on the inner surface of the hose and thereby intensified the turbulence of the oil.

3. At the same pressure drop, the 6-inch smooth bore hose carried approximately three times as much oil as the 4-inch smooth bore hose, and the 6-inch rough bore hose carried approximately twice as much oil as the 4-inch rough bore hose.

Results of Diesel Oil Tests

The diesel oil tests were not as extensive as the fuel oil tests, but they demonstrated the advantage of using smooth bore hose. As shown in Figure 18, the carrying capacity of the 4-inch smooth bore hose was approximately one-third more than that of the 4-inch rough bore hose at the greatest pressure drops obtained.

The capacities of both the rough bore and smooth bore hose at the same pressure drop increased when the inlet pressure was changed from 50 pounds per square inch to 110 pounds per square inch. This behavior was not encountered when testing with fuel oil, although no fuel oil tests were made with such low pressure drops.

Friction Factors and Reynolds' Numbers

The conventional plots of friction factors versus Reynolds' numbers, calculated from the curves of pressure drop versus flow rate, are given in Figures 19 to 26, inclusive. The friction factor curves enable the

TABLE I—TEMPERATURES, VISCOSITIES AND SPECIFIC GRAVITIES OF OILS DURING TESTS

Hose Size	Position	Oil	Upstream Pressure (psi)	Maximum Temperature (°F.)	Minimum Temperature (°F.)	Average Temperature (°F.)	Maximum Viscosity (centipoises)	Minimum Viscosity (centipoises)	Average Viscosity (centipoises)	Maximum Specific Gravity	Minimum Specific Gravity	Average Specific Gravity
4-inch	Horizontal	Fuel	50	106	103	104	52	48	50	0.9559	0.9549	0.9555
			110	105	102	103	53	49	52	0.9561	0.9552	0.9559
			150	102	98	100	59	53	56	0.9577	0.9561	0.9568
4-inch	Draped	Fuel	50	94	94	94	86	86	86	0.9488	0.9488	0.9488
			110	97	93	95	89	78	84	0.9493	0.9474	0.9483
			150	99	92	96	92	74	80	0.9499	0.9464	0.9478
6-inch	Horizontal	Fuel	50	122	120	121	47	45	46	0.9402	0.9397	0.9399
			110	122	122	122	45	45	45	0.9397	0.9397	0.9397
			150	122	122	122	45	45	45	0.9397	0.9397	0.9397
6-inch	Draped	Fuel	50	118	116	117	54	52	53	0.9421	0.9416	0.9419
			110	122	118	120	52	47	49	0.9416	0.9410	0.9413
			150	123	120	122	49	46	47	0.9413	0.9408	0.9410
4-inch	Horizontal	Diesel	50	78	76	78	7.4	7.2	7.3	0.8850	0.8847	0.8850
			110	78	76	78	7.4	7.2	7.3	0.8850	0.8847	0.8850

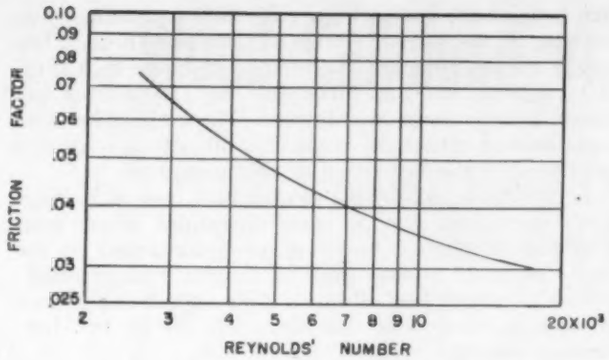


FIG. 19—Friction factor vs. Reynolds' number for horizontal 4-inch smooth bore hose carrying fuel oil.

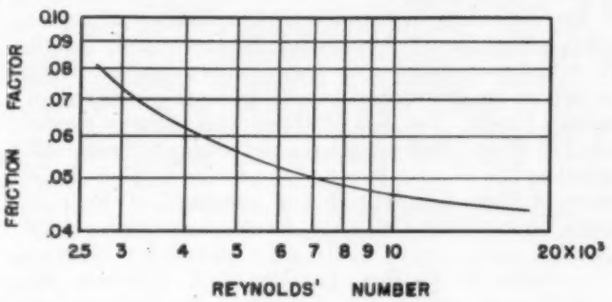


FIG. 20—Friction factor vs Reynolds' number for horizontal 4-inch rough bore hose carrying fuel oil.

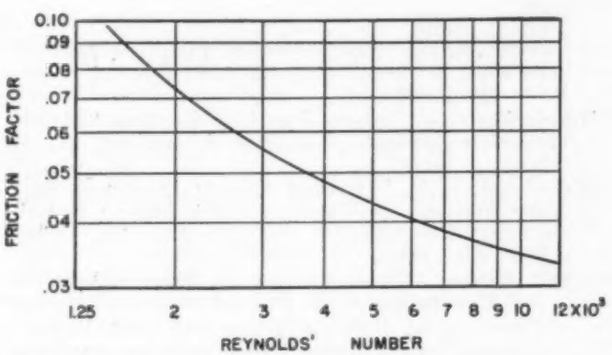


FIG. 21—Friction factor vs Reynolds' number for draped 4-inch smooth bore hose carrying fuel oil.

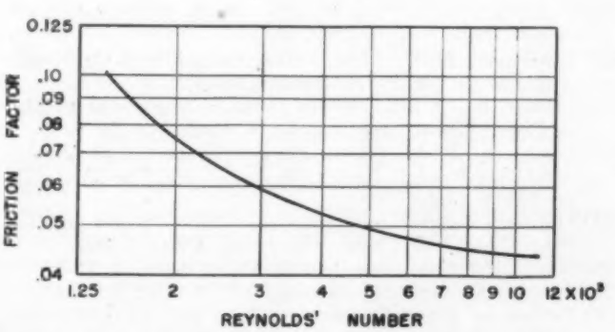


FIG. 22—Friction factor vs Reynolds' number for draped 4-inch rough bore hose carrying fuel oil.

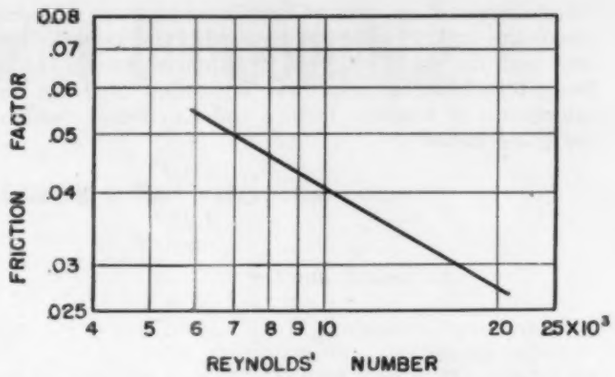


FIG. 23—Friction factor vs Reynolds' number for horizontal 6-inch smooth bore hose carrying fuel oil.

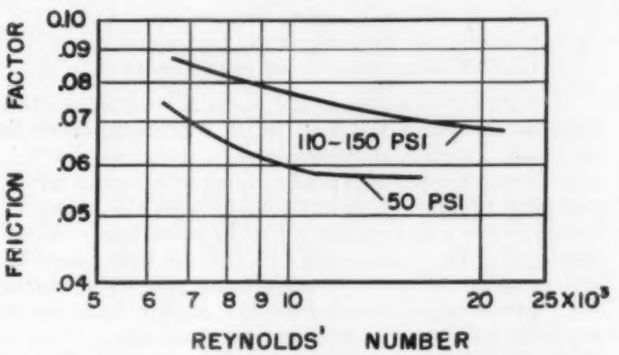


FIG. 24—Friction factor vs Reynolds' number for horizontal 6-inch rough bore hose carrying fuel oil.

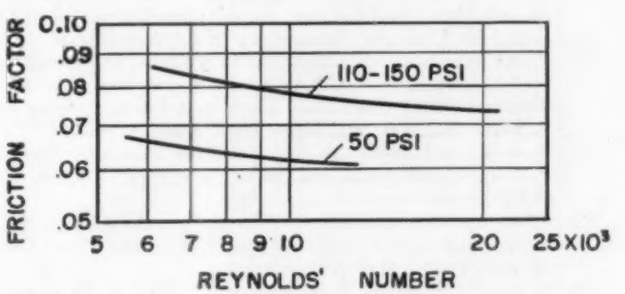


FIG. 25—Friction factor vs Reynolds' number for draped 6-inch rough bore hose carrying fuel oil.

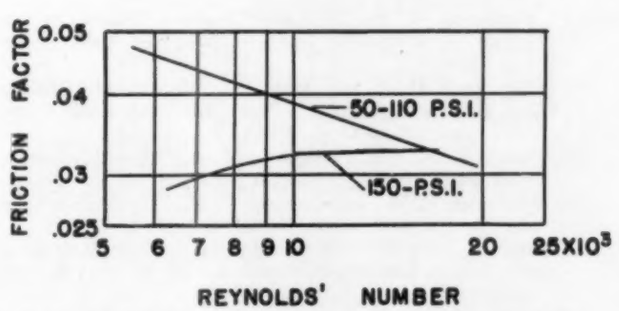


FIG. 26—Friction factor vs Reynolds' number for draped 6-inch smooth bore hose carrying fuel oil.

calculation of flow rates of liquids which have different viscosities and densities in hose with the same diameters and the same degrees of internal roughness as those tested. The respective equations used for the calculation of friction factors and Reynolds' numbers are given below:

$$\text{Friction factor} = \frac{2gDP}{LdV^2}$$

$$\text{Reynolds' number} = \frac{DVd}{u}$$

g = acceleration due to gravity (32.16 feet per second per second),
D = inside diameter of hose in feet,
P = pressure drop in pounds per square inch,
L = length of hose in feet,
d = density of oil in pounds per cubic foot referred to water at 60°F.,
V = velocity of flowing oil in feet per second,
u = viscosity in pounds mass per second per foot (0.000672 x viscosity in centipoises).

If there is no change in the internal roughness of the hose as the pumping pressure is increased, or if the oil is not significantly compressible, the curve for friction factor versus Reynolds' number obtained at one pumping pressure should coincide with the curve obtained at any other pressure for the same hose. It was found that the curves did coincide in five cases, but not in three. Figure 24 shows that the curve for an inlet pressure of 50 pounds per square inch in the horizontal 6-inch rough bore hose was lower than the curve for the two higher pressures. Figure 25 indicates that the same behavior occurred in the draped 6-inch rough bore hose. Figure 26 shows an anomaly in the case of the draped 6-inch smooth bore hose. The curves for the 50 and 110 pounds per square inch pressures agreed, but the curve for the 150 pounds per square inch pressure was lower. The authors have no explanation for these discrepancies other than what was mentioned at the beginning of this paragraph.

The advantages of using smooth bore hose in fueling-at-sea operations and in other operations where considerable lengths of hose are used compared to the length of fixed piping, make it desirable to gradually replace all rough fuel oil hoses with smooth bore hoses, in order to insure that our Navy will always get there "fustest with the mostest"!

ACKNOWLEDGEMENT

The extent of the program described above may be partially judged by the list of industrial and Navy personnel who cooperated with the authors. The members of the Technical Committee of the Rubber Manufacturers Association, Petroleum Refiners and Rubber Manufacturers aided with suggestions as to test design as well as by promptly furnishing needed materials of various kinds. The list of those who actively participated in the over-all program and contributed especially includes Lt. W. L. Woodruitt of the Rubber Laboratory at Mare Island; technical personnel of the Tidewater Associated Oil Co., Avon, California; Capt. Latrobe, Commander Radford, Commander MacGee, Commander H. H. Fox, Jr., Mr. R. E. Harmon, Mr E. A. Bukzin and Miss E. Levene of the Research and Standards Branch of the Bureau of Ships. Mrs. M. Houghten, who prepared the Bibliography in connection with this investigation, deserves special mention.

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(27) Bureau of Ships Specification 7-0-2 (INT) (Mar. 15, 1944).

Wood Cellulose in Rubber Compounding

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IN the past year, finely divided, purified wood cellulose (frequently referred to as "alpha flock") has been proved to be of such significant value in rubber compounding that it is felt a preliminary report of available data is in order at this time. The preliminary character of this report must be emphasized, for, admittedly, comparatively little is yet known of the full range of practical applicability of pure wood cellulose flock. Nevertheless, many problems have already been solved through its use, and it is hoped that what it now known will be of general interest. Research work on the use of this type of flock is continuing in the Brown Company's Berlin, New Hampshire, laboratory and in outside research laboratories with the view of making a more complete report at a later date.

Pure cellulose flock is not generally used as a reinforcing agent with regard to tensile strength. It does, however, contribute dimensional stability and build into a compound the capacity to resist deformation. This is the prime advantage in its use in molded soles where both better appearance and better stitching characteristics are obtained. Furthermore, improved dimensional stability is distinctly desirable in a wide number of rubber end products and the current commercial availability of pure cellulose flock in a variety of finenesses, including real powders, has greatly extended the field of application.

At this stage of the development, practical significance is attached to the observation that cellulose exhibits similar properties when used with various synthetic elastomers as well as with natural rubber. Figures 1, 2, and 3 give basic results with smoked sheet, GR-S and GR-M, respectively. The fact that pure cellulose flock has no significant effect on the rate of cure is illustrated by the data in Figure 4.

As a general processing aid, up to 10 parts by weight pure cellulose flock contributes reduced shrinkage and improved dimensional stability in both uncured and cured rubber stocks. As a result, better and smoother surfaces are obtained in both calendering and extruding operations. It is, therefore, important that such amounts of pure cellulose flock have no untoward effects on tensile, elongation, and cure rate. That this is so in the compounds studied will be seen from the data in Figures 1 to 4.

As a low cost filler, pure cellulose flock possesses certain strictly novel characteristics which will be discussed in more detail below. It has a radically low specific gravity and it contributes remarkable increases in durometer hardness with surprisingly low corresponding increases in modulus. At a given hardness level, its compounds are characterized by high flex life and resistance to cut growth.

Since cellulose flock is a fibrous and bulky material, it has from time to time required special thought and study with regard to proper dispersion in rubber products. This has been more important in two-roll mixing than in Banbury mixing. Where a roll mill is used it is proper to mill the flock into the dry rubber before much breakdown has occurred, in order to obtain maximum grinding action.

The best method for dispersing the longer cellulose

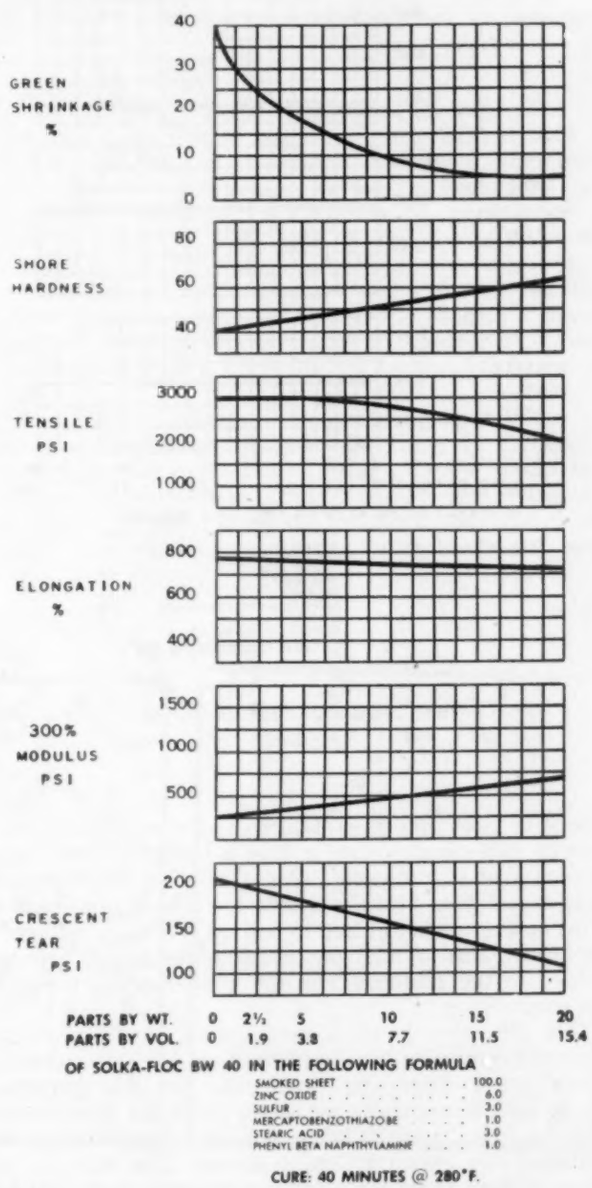


FIG. 1—Pure cellulose flock in natural rubber (Test Compound A).

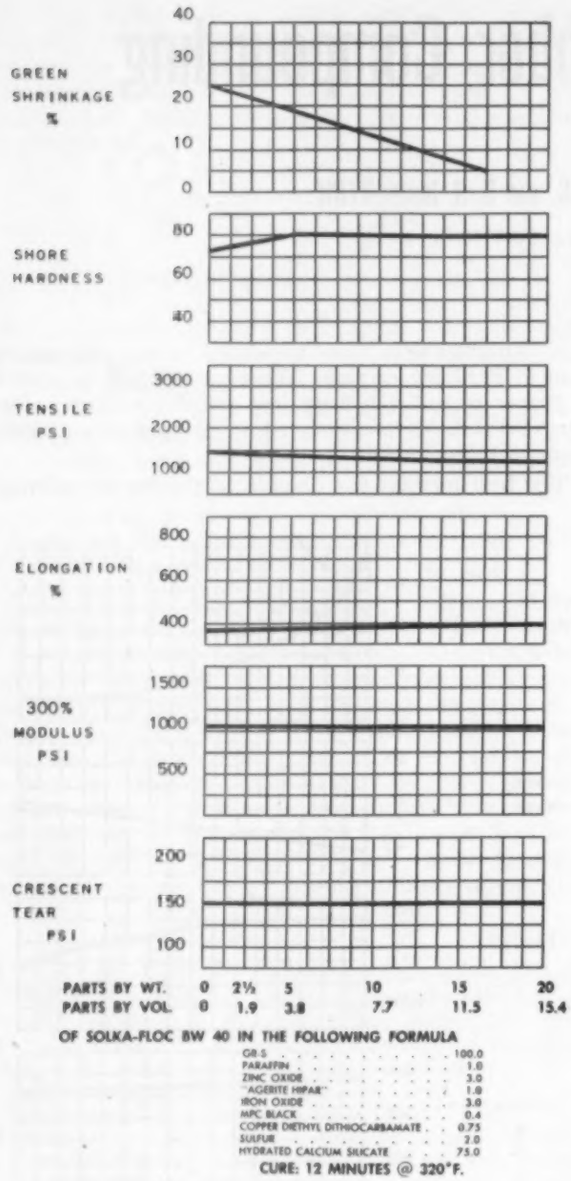


FIG. 2—Pure cellulose flock in GR-S (Test Compound B).

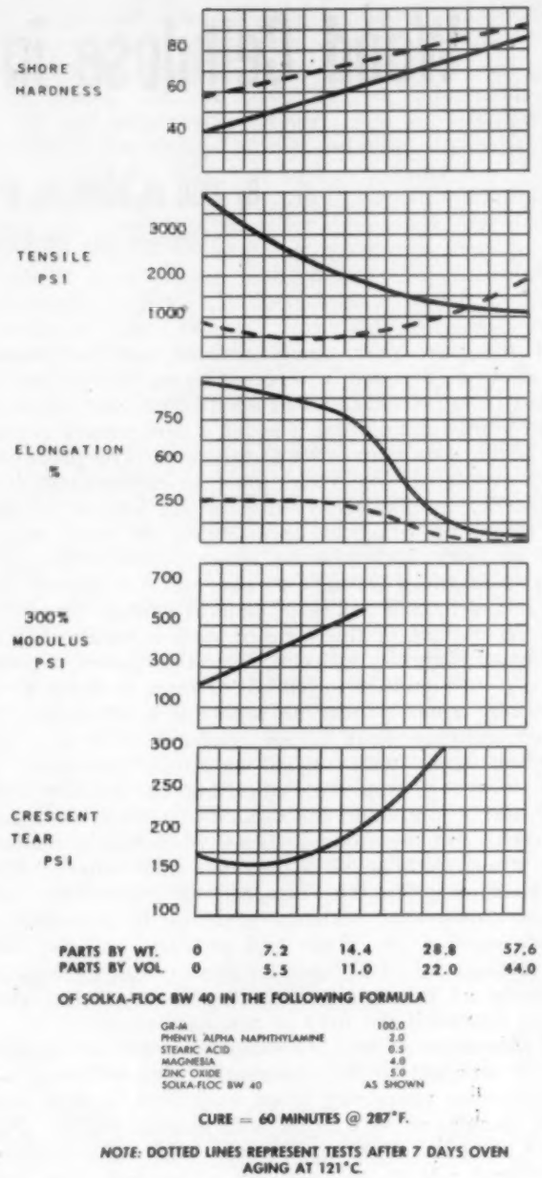


FIG. 3—Pure cellulose flock in GR-M (Test Compound C).

fibres is to charge them to a Banbury and tumble for one or two minutes with at least a portion of other required dry ingredients. This serves to separate the longer cellulose fibres and coat them with non-fibrous dust so that any tendency to ball up is greatly reduced. Following this preliminary tumbling, the rubber may be added to the Banbury and the compounding proceed as usual.

On the other hand, a modification in the physical form of cellulose fibres has been found to satisfactorily answer any dispersing problems. For this purpose, there are commercially available, under the trade name "Solka Floc," pure cellulose powders manufactured to substantially pass a 100-mesh screen. The way one of these differs from the more conventional flock will be seen from the photomicrographs in Figure 5. Such powders have been found to be practically equivalent in rubber compounds to the longer fibered and bulkier materials and, because of their greater fineness, they may be properly dispersed in any desired sequence and without special precautions. They avoid all need for master-batching and, in addition, give greater resilience and flex life at a given hardness level.

Some of the Effects Obtainable

Improved Dimensional Stability: The fundamental characteristic of cellulose of contributing improved dimensional stability to rubber (and plastics) compounds is the basis for its wide utility. Presumably because of its fibrous nature, it is unusually effective in contributing a high degree of firmness and resistance to cold flow. This is attained along with unusual resilience and lack of brittleness because the cellulose

itself is soft and non-crystalline in comparison to other non-black fillers. These characteristics have led to use of pure cellulose flock in floor and wall tile, as exemplified by the test data in Figure 6.

Reduced or Controlled Shrinkage: The use of small amounts of pure cellulose flock serves to give body to uncured rubber compounds so that they may be handled without great physical deformation. This effect is shown in Figure 7 where results with both GR-S and natural rubber are shown. The rate of decrease of green shrinkage in the unloaded rubber stock is very sharp as compared to the rate of decrease of shrinkage in the loaded GR-S stock. It should be pointed out that for a wide variety of rubber compounds a similar curve will be obtained when green shrinkage is plotted against percent cellulose. The principal difference as the degree of loading of the compound is varied will be the slope of the curve obtained. Thus, the reduction in shrinkage through the use of pure cellulose flock is greatest in an unloaded stock, but significant reductions are also obtained in highly loaded compounds.

In addition to reduction of green shrinkage, the use of pure cellulose flock has an important effect in the reduction of shrinkage occurring during curing. For molded goods, this permits establishment of uniform specifications for shrinkage, and in the case of some calendered goods, the use of a small amount of pure cellulose flock is almost essential. An example of the latter case is the production of calendered footwear where a shoe built up by cementing may undergo such shrinkage during curing that it pulls loose at the seams. In such a case, the simple addition of a few parts of pure cellulose flock to the base stock will control the cured shrinkage at the necessary operating level.

Increased Durometer Hardness: In Figure 8, it may be seen that the addition of pure cellulose flock to an unloaded natural rubber stock very materially increases the hardness of the product. Over a range of 40 to 60 Shore durometer, at least, this is proportional to the amount of pure cellulose flock employed, each part

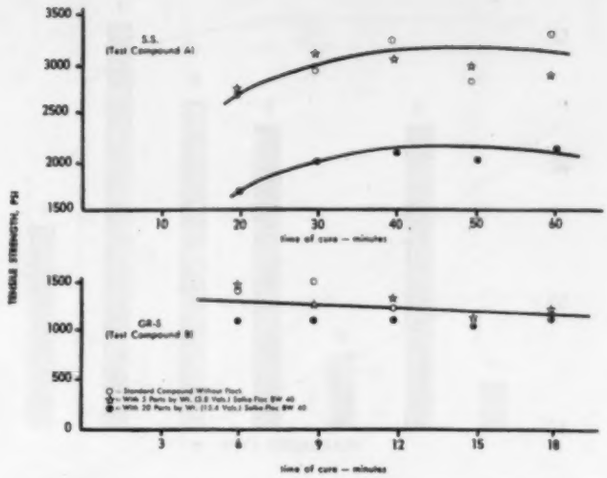
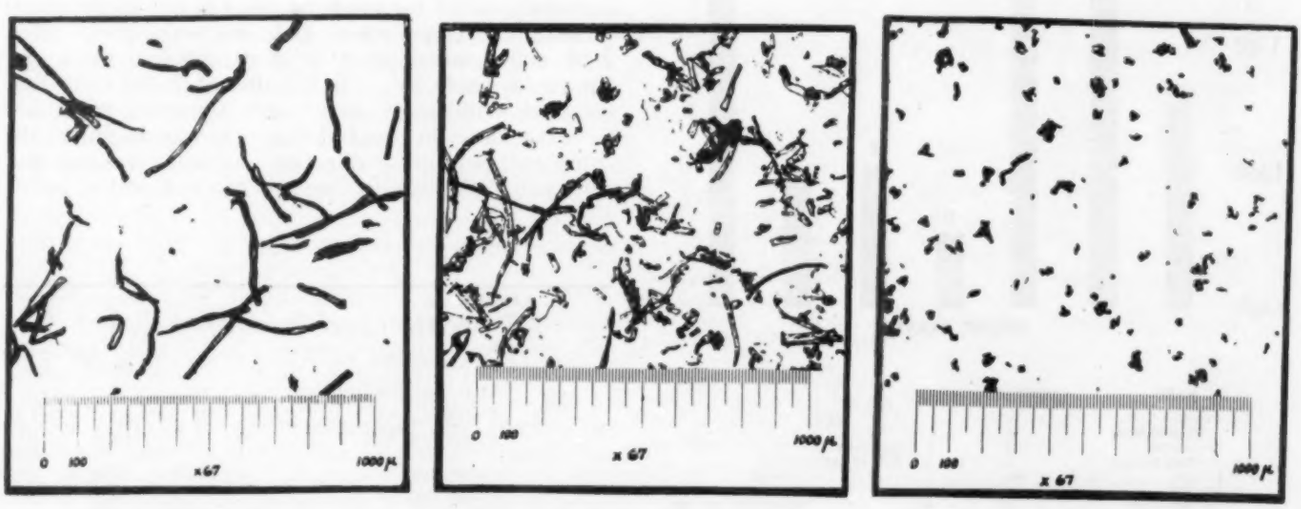


FIG. 4—Effect of pure cellulose flock on cure rate.

by weight giving one hardness unit increase. For 60 durometer, the volume loading of pure cellulose flock is roughly one-third that required when using other non-black fillers; in most cases, the weight loading is only one-sixth. Likewise, the addition of pure cellulose flock to a loaded GR-S stock which already possesses a hardness of 75 gives a significant increase in this value. Perhaps because of the lower volume loading required, use of pure cellulose flock to gain a given hardness level produces stocks of greater resilience and flex life than is generally the case with other non-blacks.

Durometer hardness and corresponding modulus of various compounds are given in Table I. Curiously enough, in the case of the loaded GR-S a significant increase in hardness is obtained without increasing the modulus. In the case of the unloaded natural rubber stock, very material increases in hardness are obtained



COTTON FLOCK **SOLKA-FLOC BW 40** **SOLKA-FLOC BW 200**

FIG. 5—Photomicrographs.

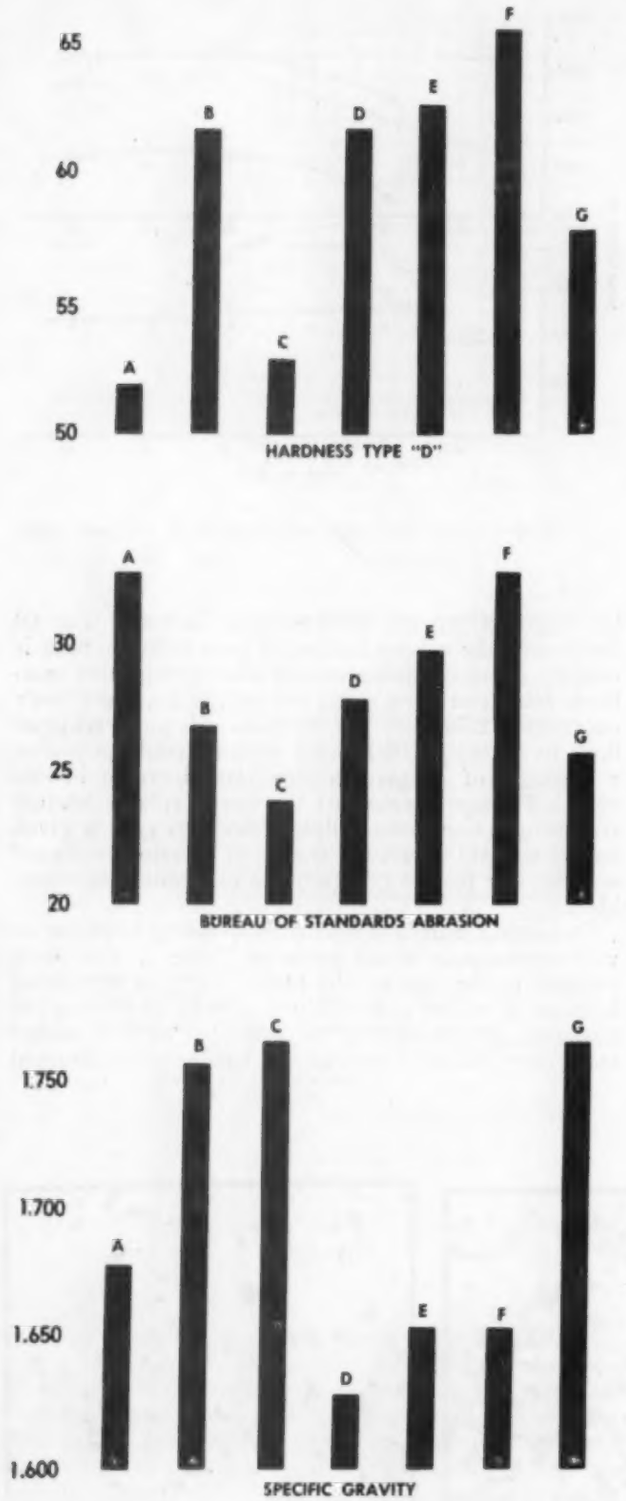


FIG. 6—Pure cellulose flock in tiling stock.

TABLE I—HARDNESS AND MODULUS

Solka-Floc BW 40					
Parts by Wt.....	0	2.5	5	10	20
Parts by Vol.....	0	1.9	3.8	7.7	15.4
S.S. (Test Compound A)—Cure, 40 minutes @ 280° F.					
Durometer Hardness.	40	44	46	50	59
300% Modulus	160	240	260	260	380
500% Modulus	450	550	550	610	780
GR-S (Test Compound B)—Cure, 12 minutes @ 320° F.					
Durometer Hardness.	75	78	80	81	81
300% Modulus	1080	1100	1000	1150	1000

through the use of pure cellulose flock with relatively low increases in modulus.

Lighter Weight: Since the true specific gravity of pure cellulose is 1.58 and some of the flock products are manufactured so that they exhibit in loaded rubber compounds a working specific gravity of only approximately 1.3, the use of pure cellulose flocks in the place of other fillers is of great importance in producing low gravity and light weight products. From the data in Table II, it will be seen that a natural rubber stock can be taken to about 60 hardness with pure cellulose flock while maintaining a specific gravity of only 1.051. This is a novel characteristic of this type of product when used as a non-black filler.

Lower Cost: The compound costs of high quality products can frequently be reduced without sacrifice of quality through the addition of pure cellulose flock. Table III gives data on an improved sole stock with and without the addition of relatively lower cost cellulose. It will be noted that either coarse or fine pure cellulose flock may be employed in substantial amounts without significantly impairing quality. Aside from better dimensional stability resulting from the use of pure cellulose flock, improvements in tear strength or low temperature flexibility are indicated.

In an analogous manner, pure cellulose flock is eminently suited for lowering costs in the manufacture of neoprene crepe soles. Data on such stocks filled with either wood flour or pure cellulose flock are shown in Table IV. The significant factors are that the pure cellulose flock not only improves resistance to deformation in use, but that it is translucent in the compound permitting retention of fine appearance and colorability. This is in contra-distinction to the use of

TABLE II—LIGHT WEIGHT PRODUCTS

S.S. (Test Compound A)—Cure, 40 minutes @ 280° F.

Solka-Floc BW 40		
Parts by Wt.....	10	20
Parts by Vol.....	7.7	15.4
Tensile, psi	2620	2070
Elongation, %	753	687
300% Modulus	260	380
Durometer Hardness	50	59
Specific Gravity	1.016	1.051

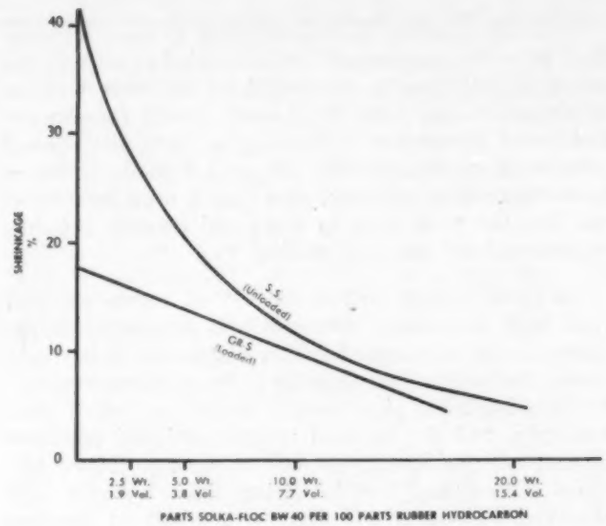


FIG. 7—Effect of pure cellulose flock on shrinkage.

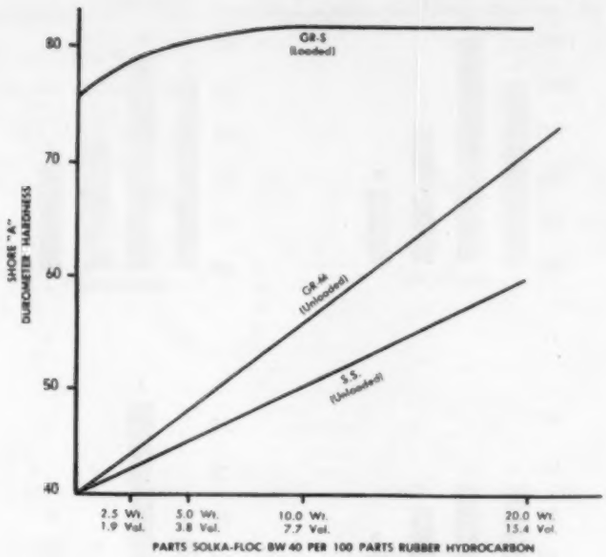


FIG. 8—Effect of pure cellulose flock on durometer hardness.

wood flour which produces a decidedly mottled effect. For best dispersion and clarity of pure cellulose flock in neoprene, it is recommended that it first be masterbatched.

Improved Color: Pure cellulose is entirely non-marking and non-staining. Some grades are of exceptionally high whiteness and, therefore, enable production of white and light colored goods of the desired hardness where many rubber fillers cannot be used. While white cellulose flock has no inherent pigmenting value in rubber compounds and thus can be used to produce translucent products, in comparison with most non-blacks it enables savings in scarce pigments in the production of white and red stocks. In the production of pure cellulose flock from wood, multiple chemical and physical operations are utilized so that it possesses a uniformity of manufacture which justifies steady dependence on performance in colored rubber goods.

Flex Life: While the incorporation of cellulose fibre increases the hardness and dimensional stability of a rubber compound, these changes must be balanced by maintaining adequate flexing characteristics and resilience. The choice of flock for soles was made because controlled proportions will give adequate dimensional stability with a minimum of sacrifice of flex life.

During the past year, it has been demonstrated that cellulose powders are approximately equally effective as bulkier flocks in contributing dimensional stability and, at the same time, greatly superior with regard to flex life of the resulting compound. Table V shows a comparison of the results obtained in a given GR-S stock through the use of different fibre length cellulose products. Results of a separate study comparing different flocks in a sole stock are shown in Figure 9. The improvement in flex life obtained through the use of shorter fibres is very material and has resulted in making possible the use of much larger percentages of cellulose.

It is impossible at the present preliminary stage of the investigation of the use of pure cellulose flock to estimate the ultimate practical limit of the usefulness of this material as non-black filler, but the prospects are

TABLE III—PURE CELLULOSE FLOCK IN COPOLYMER RESIN SOLE STOCK

(Courtesy, B. F. Goodrich Chemical Co.)

Base Stock Formula

GR-S	100
Goodrite 50	42.8
ZnO	7.14
Stearic Acid	4.28
Iron Oxide (Red)	2.86
Polymerized Aromatic Resin	28.6
Polymerized Trimethyl Dihydroquinoline	2.86
MPC Black	0.143
Benzothiazyl Disulfide	2.86
Tetramethyl Thiuram Disulfide	0.143
Hydrated Calcium Silicate	57.2
Sulfur	3.57
	252.556

Milled @ 175° F., Minimum (this is critical)

	Base Stock	Base Stock Plus 21.2 Parts Solka-Floc BW 40	Base Stock Plus 21.2 Parts Solka-Floc BW 200
Tensile, psi	1675	1250	1125
Elongation, %	430	300	460
300% Modulus, psi	1300	1250	900
Specific Gravity	1.194	1.210	1.200
Durometer Hardness	91	92	89
Low Temperature Bend, °F.	Passed-40	Passed-40	Passed-50
ZZ R 69A Abrasion Index	34	31	30
Bureau of Standards Abrasion (B Standard), %	—	—	46
Crescent Tear, psi	240	295	240
Aged 24 hours @ 212° F.			
Ross Flex Test Cut growth @ 200,000 flexes	0.45"	0.40"	0.50"

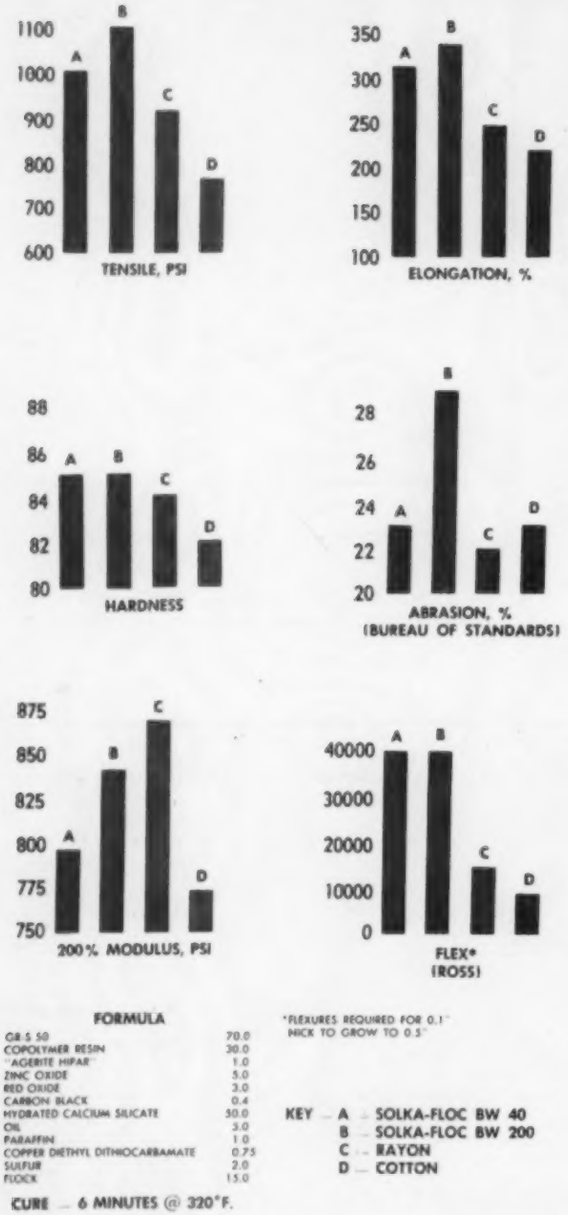


FIG. 9—Comparison of different flocks in a sole stock.

intriguing. Actually, some soles, electrical plugs, and sundries have already been made using pure cellulose as the principal or only filler and these products possess appropriate hardness and resilience or flex life, along with high dimensional stability.

Smoother Surfaces: Only a few parts of pure cellulose flock are required in the formula in order to obtain significant reduction of tuber swell and calender shrinkage, promote smoother surfaces in each case, and permit increased tubing speeds. These effects are undoubtedly related to the basic characteristic of the cellulose fibre of reducing shrinkage and contributing a certain amount of firmness and stability to the uncured compound.

Better Embossing: A characteristic of pure cellulose flock in rubber compounds which has led to wide application is its capacity to contribute stiffness without brittleness. This property is made use of for sharper and more permanent embossing of both dry mixed calendered goods and fabric supported goods produced by wet spreading. In the latter case, it must be pointed out that the flock may be dispersed directly into the cement without previous milling.

Uniform Sponge: Since the use of a few parts of this flock contributes firmness and resistance to deformation to an uncured rubber compound, it has been found that when this is applied to blown sponge rubber, the blowing takes place over a shorter period of time, suddenly, and the finished article produced possesses an unusual uniformity of cell structure. More uniform curing and less blistering have likewise been observed. These effects may be a result of bleeding of gas from fiber ends.

Good Electrical Properties: Heavily loaded rubber compounds containing pure cellulose flock show improved electrical properties over compounds of equal hardness containing carbon black. An appreciable amount of this flock may be used in mineral filled compounds without significantly lowering dielectric strength, as is shown by the data in Table VI.

Latex Compounding: Pure cellulose flock is readily dispersible in aqueous systems and such dispersions may be stabilized by the presence of various cellulose derivatives. This fact, and the very low specific gravity of cellulose, have led to its adoption in numerous latex compounds.

Special Surface Finishes: Cured rubber compounds containing ten or more parts of pure cellulose flock may be buffed to produce a surface containing a certain amount of free fibre and exhibiting a nap-like appearance.

Physical Varieties of Pure Cellulose Flock

There are, of course, a great number of flock products on the market and a wide variety of physical

TABLE IV—PURE CELLULOSE FLOCK IN NEOPRENE CREPE SOLE

Formulae		
Neoprene S	100	100
Coumarone-indene Resin	5	5
Wood Flour	20	—
Solka-Floc BW 200	—	20
Oil	5	5
Sodium Acetate (60% crystals)	1	1
Tests		
Tensile, psi.	515	535
Elongation at Break, %	375	375
200% Modulus, psi.	400	375
Tear, lbs. per inch	93	116
Durometer Hardness	44	42
Bureau of Standards Abrasion, %	20	20
Linear Shrinkage, %	11.5	11.85
Specific Gravity	1.216	1.231

TABLE V—DE MATTIA FLEX CRACK TESTS

Unaged Stocks—Tested at Room Temperature
GR-S (Test Compound B)—Cure, 17 minutes at 320° F.
Flock—15 Parts by Weight (11.5 Parts by Vol.)
(Cut Growth at Flexes—Reported in Hundredths of an Inch)

Flex Cycles.....	300	600	900	1200	1500	1800	2100	2400	2700	3000	3300	3600	3900	4200	4500	4800	5100	5400
Solka-Floc AW 40																		
(1)	42	62	74	78	84	90 Broke	—	—	—	—	—	—	—	—	—	—	—	—
(2)	44	62	78	92	94	96	98 Broke	—	—	—	—	—	—	—	—	—	—	—
(3)	48	68	80	86	94 Broke	—	—	—	—	—	—	—	—	—	—	—	—	—
Solka-Floc BW 40																		
(1)	44	62	82 Broke	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
(2)	40	72	86	94 Broke	—	—	—	—	—	—	—	—	—	—	—	—	—	—
(3)	40	68	90	98 Broke	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Solka-Floc BW 200																		
(1)	4	26	54	70	86	94	98 Broke	—	—	—	—	—	—	—	—	—	—	—
(2)	10	28	42	58	68	82	84	90	92	94	94	96 Broke	—	—	—	—	—	—
(3)	6	26	44	58	68	78	82	84	86	86	86	86	86	86	88	92	96 Broke	
Cotton Flock																		
(1)	46	78 Broke	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
(2)	48	78	94 Broke	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
(3)	38	92 Broke	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

forms. This is significant for meeting the requirements of a multitude of rubber end products. The multiple chemical and physical operations utilized to produce pure wood cellulose flock not only support this variety, but also contribute a high uniformity of manufacture to each item in each grade.

Pure cellulose flock may originate from several types of wood, in varying degrees of whiteness, at several levels of bulkiness, and in a number of finenesses. A tabulation of typical physical characteristics obtainable is shown in Table VII. It will be noted that average fibre lengths vary all the way from approximately 250 microns down to about 25 microns. The finer flocks are actual powders of low bulk which are extremely free flowing and easy to compound.

Uses Many and Varied

While there appears, at this preliminary stage, to be no limit to the range of finished rubber goods which may be improved through the incorporation of pure cellulose flock, the following list of such end products is offered as an indication of how wide its application has been in the past year: Calendered Footwear, Molded Soles, Crepe Soles, Household Goods, Drug Sundries, Flooring and Matting, Sports' Goods, Stationers' Goods, Toys and Novelties, Electrical Goods, Tire Curing Bags, Tire Bead Compound, Proofed Goods, Sponge, Adhesives, Hard Rubber, Mountings, Packings, Plumbers' Specialties, Rolls, Automotive Specialties, Foamed Latex, Tiling, and Tank Liners.

TABLE VI—EFFECT OF PURE CELLULOSE FLOCK ON DIELECTRIC STRENGTH

	Dry	After 16 Hours Soaking in Water
Control *	48×10^{12} ohms/cm³	24×10^{12} ohms/cm³
With 8 Parts Solka-Floc BW 40....	34×10^{12} ohms/cm³	18×10^{12} ohms/cm³

* 37% GR-S with clay and whiting fillers.

TABLE VII—TYPICAL PHYSICAL CHARACTERISTICS OF PURE CELLULOSE FLOCK

Type of Solka-Floc	AW 40	AW 100	AW 200	BW 40	BW 100	BW 200	BNB 40	BNB 100	BNB 200
Brightness	75	75	77	82	83	83	25	22	19
Color	White	White	White	White	White	White	Brown	Brown	Brown
Approx. Av. Particle Size, microns..	250	60	40	150	45	25	100	55	40
Approx. Screen Analysis									
% Thru 100 mesh.....	65	95	97	65	93	97	68	98	99
% Thru 200 mesh.....	35	70	77	40	67	78	39	80	85
Moisture, %									
Max. @ 65% R.H.....	8	11	9	8	11	9	8	9	8
Approx. as Shipped.....	5	7	7	5	7	7	5	6	6
Specific Gravity									
True	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58
Apparent (in loaded rubber).....	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Apparent Density									
Dry, lbs./cu. ft.	15	32	34	14	31	34	16	27	28
Bulk, cc/gram	4.1	1.9	1.9	4.0	2.0	2.0	3.9	2.3	2.2

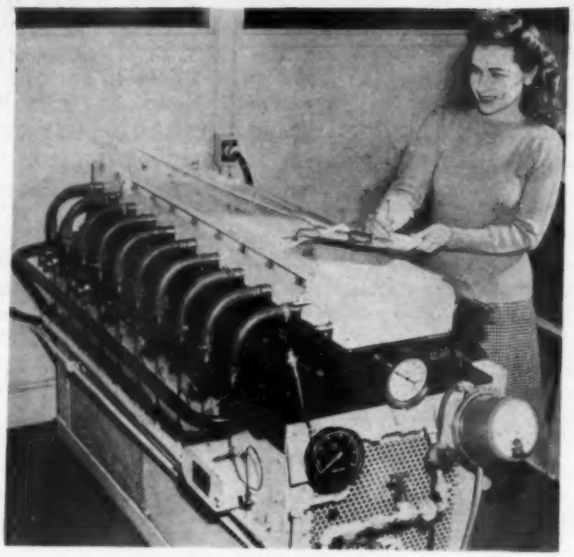
New Goodyear Device Tests Twenty Tire Fabrics Simultaneously

THE whirling spindles of a new testing machine developed at the Goodyear Research Laboratory in Akron will tell in a few hours as much about a new tire fabric as could be learned in a 20,000 mile road test. More than that, the new machine can test 20 fabrics simultaneously so that its findings in a few hours equal nearly 500,000 miles of road testing.

Designed by G. D. Mallory, the new machine is known as the Goodyear Flex-Tester. It is about the size of an ordinary flat-top desk, and its effectiveness arises from the fact that it subjects a tire fabric to the same sort of strain that it would have to endure in an actual tire. Heretofore, according to Dr. L. B. Sebrell, director of the Goodyear Research Laboratory, there has been no way of doing this. Consequently, the only satisfactory way to test a new tire fabric was to use it for the cords of an experimental tire.

While various fabric testing machines have been made in the past, these did not simulate road conditions. Consequently, there was no satisfactory way of testing out a new strain of cotton fiber or a new synthetic fiber except to make up a full-size tire, put the tire on an automobile and send it out for a road test. Mile after mile, over city and country roads, the test chauffeur drove his car until the experimental tire gave out. The process was expensive and time consuming.

To test a fabric with the new machine, it is only necessary to make up a section of a miniature tire about the thickness of a garden hose and about one foot in length. Each unit of the flex-tester consists of two revolving spindles, the upper one in a horizontal position, the lower one in a vertical position. The miniature tire section or tube to be tested is fastened to the two spindles. Since the spindles are at right angles to each other, the tube is bent into a 90-degree angle. Air is then pumped into it under pressure just as in an ordinary tire. Next the spindles are set in rotation. This subjects the portion of the tube which is bent to a continuous stress that duplicates the stresses that would be endured in a road test.



Goodyear Flex-Tester Machine

At any given instant, the fabric on the inner curve of the angle is compressed while that on the outer side of the angle is stretched. But due to the turning of the spindles, any given point on the angle moves from the inner side to the outer side and back again with every revolution. Consequently, the fabric is subjected to precisely the same alternations of compression and stretch that it must withstand in an actual tire. The spindles revolve at any desired speed up to 1,000 revolutions per minute or more.

Tests with tubes or miniature tire sections made up with cords now in general use showed that they were good for 700,000 to 1,000,000 revolutions on the flex-tester. This established a standard for the rating of experimental cords.

Hungerford Process for Compounding Thermoplastic Materials

A NEW process for the compounding of thermoplastic materials, including the cellulosic plastics, polyvinyl acetate chloride, polyvinyl chloride, polyvinyl acetal, and polyvinyl butyral, has been developed by the Hungerford Plastics Corp., Murray Hill, N. J. The process, called the Hungerford Process, is said to permit the compounding of thermoplastic materials without the use of solvents or slurries or without the necessity of fusing the mass and subsequently subjecting it to mechanical disintegration.

The new process is said to be fundamentally different from the solvent method, the Banbury method, and the hot roll method of compounding plastic materials in that the material remains in powder form throughout the process. The principal advantage claimed for this process is that it permits a wide flexibility of formulation and color with a comparatively small raw material inventory.

According to the company, the process, as now perfected, is very simple. The flake or resin, the dye, pigment, stabilizer, fillers, etc., are charged into a compounding chamber of a mixing machine, known as the Plastimaker, mounted so that it can be rotated. While the chamber is rotating at a very low rate of speed, the plasticizers and other liquid additives are injected into the chamber by means of a spray. The compounding chamber continues to revolve at the same rate of speed throughout the plasticizer cycle.

After the completion of the plasticizer cycle, the dehydration cycle is started. Dehydration is accomplished by filtering a volume of dry, hot air through the material. This air is automatically and continuously exhausted to the atmosphere throughout the cycle. The componded material is ready for molding at the end of the dehydration cycle.

The same general principle of compounding is used for all thermoplastic materials, except that cycles and conditions are varied in accordance with the materials and formulation. The over-all compounding time is generally less for vinyls than for the cellulosics.

Development and Standardization of Tests for Evaluating the Processibility of Rubber

(Concluded from Preceding Issue)

By ROLLA H. TAYLOR[1], J. H. FIELDING[2], and M. MOONEY[3]

In an attempt to evaluate relative rates of cure of GR-S at the National Bureau of Standards, difficulty was encountered in obtaining sufficient reproducibility to distinguish between the small differences which existed in regular production. It was found that the results were appreciably affected by two factors: (1) the integrated average temperature of the test specimen in the die cavity; and (2) the amount of moisture in the sample. In order to get the desired reproducibility it has been necessary to standardize carefully each condition and each operation.

The temperatures indicated by the platen thermometers are not sufficiently close to the temperature of the test specimen in the die cavity to permit their use for determining the true temperature curve of the test. In order to determine this curve, iron-constantan thermocouples were placed in the bottom of the plungers. The leads were run through the plungers to a small brass plug in which the junction was silver soldered. This plug was insulated from the plunger by means of a small fiber bushing. The two thermocouples were then connected in parallel to give an average reading. Prior to the installation of the Brown recorder, the temperature curves were obtained with a high quality potentiometer. With the multiple unit recorder, simultaneous temperature and viscosity curves are recorded.

Temperature-time curves of the sample under test have been made reproducible within ± ½°F. at all points by the following procedure: (1) The platens of the viscometer are insulated with a ⅜-inch layer of asbestos cement, covered with a sheet metal shield; (2) The die cavity of the viscometer is brought to an equilibrium temperature of 300°F. as measured by the thermocouples. To do this, the platens are heated either by steam or electricity using the controls shown in Fig. 5. Precaution is taken to have both platens at the same temperature according to the platen thermometers; (3) After each test and before the next, the die cavity is brought to the equilibrium temperature; and (4) The test specimens are placed in the die cavity as rapidly as possible so as to keep at a minimum the period of the time that the dies remain open.

The moisture content of the sample at the time of test has a marked influence on the results. In GR-S, the rate of cure increases with moisture content *(21, 22)*, while in GR-M and GR-I it decreases. The moisture content depends upon the moisture content of the rubber and compounding ingredients, the temperature and humidity conditions during compounding, and the relative humidity at which the compounded stock is aged prior to testing. Up to the present time, only the latter condition has been controlled. The reproducibility of the results has been greatly increased by placing the test specimens in an atmosphere of 20 per cent relative humidity immediately after compounding and aging them for 24 hours prior to testing. This humidity was selected for aging the test specimens on the basis of tests made at approximately 0, 30, 50, 80, and 100 per cent relative humidities. These tests indicated that specimens aged at 20 per cent humidity would show little gain or loss of moisture.

The results that can be obtained by controlling the temperature and humidity as outlined above are illustrated in Fig. 12. Two viscosity- and temperature-time curves selected at random from a number of tests made on different days are shown for each of the reference lots X-289 and X-346 GR-S. For convenience, the cure factor has been arbitrarily defined at the National Bureau of Standards as the time required after starting the motor for the viscosity to increase 40 units above the minimum, using the large rotor. No attempt has been made to define the scorch time as was done by Juve *(20)*, since the time at which the

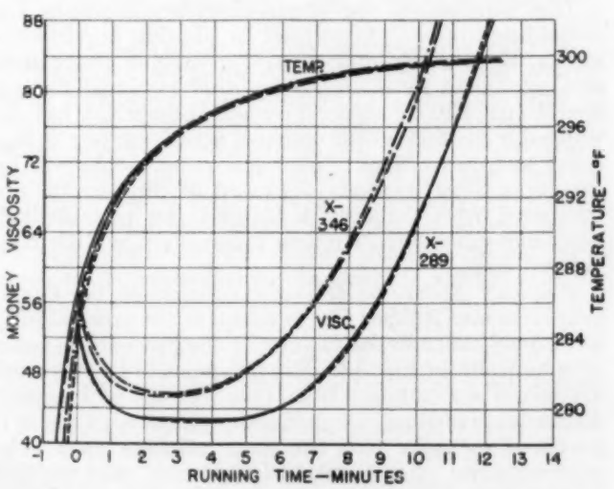


FIG. 12—Cure characteristics of two GR-S polymers —standard test recipe.

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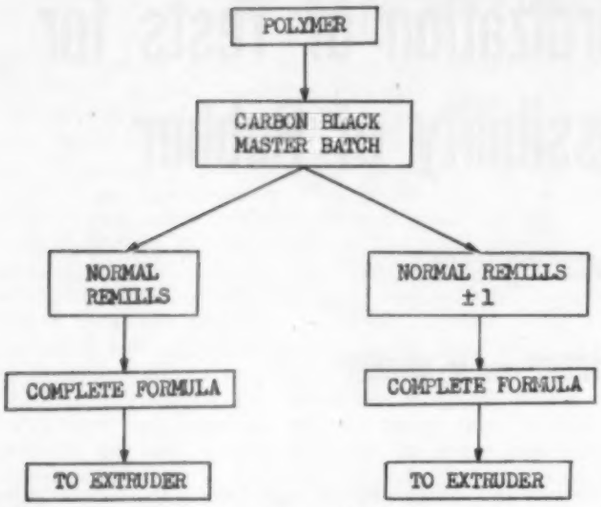

FIG. 13—Schematic diagram of procedure for determining processibility ratings by the factory method.

viscosity begins to rise above the minimum value cannot be precisely determined. The cure factors determined from the curves shown in Fig. 12 are 11.8 minutes for X-289 and 10.6 minutes for X-346 GR-S. Thus, X-346 has a cure factor approximately 10 per cent less than X-289, indicating a shorter time of cure.

It is interesting to note that the following vulcanization constants calculated from measurements of elongation at 600 psi by the procedure developed at the National Bureau of Standards and reported in another paper of this symposium *(23)* indicate the same relative cure characteristics for these two polymers:

Polymer	X-346	X-289
Parameter:		
Scorch Time (min.)	10.9	12.1
Elongation at Infinite Time of Cure (%)	135	138
Reaction Rate Constant (%/min.)	265×10^{-4}	239×10^{-4}

Other Methods For Evaluating Processibility

This portion of the paper describes methods for evaluating processibility which, in addition to measurements of viscosity and recovery, involve procedures and equipment simulating those used in actual factory operations. The Goodyear Tire and Rubber Co. has developed a method which employs actual factory equipment and procedures. Since the results obtained by the three other methods discussed in this section are compared with the results obtained by this method, hereafter called the "Factory Method", it will be considered first.

FACTORY METHOD: It is the practice at the Goodyear Tire and Rubber Co. to compare the processibility of two polymers in the factory by the procedure shown schematically in Fig. 13. The polymers to be evaluated are mixed in a standard tread type formula with normal Banbury procedure. A sufficient quantity of each is prepared to make two extrusion machine runs. The masterbatches of the two polymers are then divided in half by taking alternate slabs. One half of each is then given the normal remilling procedure. The other half of each is given one more or one less remill than normal. The four remilled masterbatches are then converted to complete tread stocks in a final mixing operation. All four are then extruded with standard dies if possible, leaving the extrusion machine controls the same throughout the entire test.

Observations are made of the smoothness, torn edges, and the percentage of treads suitable for use in production. It is customary to make Mooney viscosity readings after each milling and to record the extrusion temperature as the material leaves the extruding die. Through a study of temperature and appearance, it is possible to state whether one polymer requires more additional milling than the other, and if so approximately how much.

An example of such an evaluation is shown in Fig. 14 where portions of two polymers are given (1) normal milling, and (2) one remill less than normal *(24)*. The four mixes are rated in order of processibility. It may be concluded that one of the polymers is poorer than the other in processibility and that this difference is greater than one remill.

Although subject to some errors of observation, this method is generally found to be fairly reliable. Its greatest disadvantages are that tests must be run on a factory scale and that it yields only relative results. It is usually best to say that a certain polymer has better or poorer processibility than the control and that the difference is approximately equivalent to a certain amount of milling.

LABORATORY MILL METHOD: The laboratory mill method for determining a processibility index is a

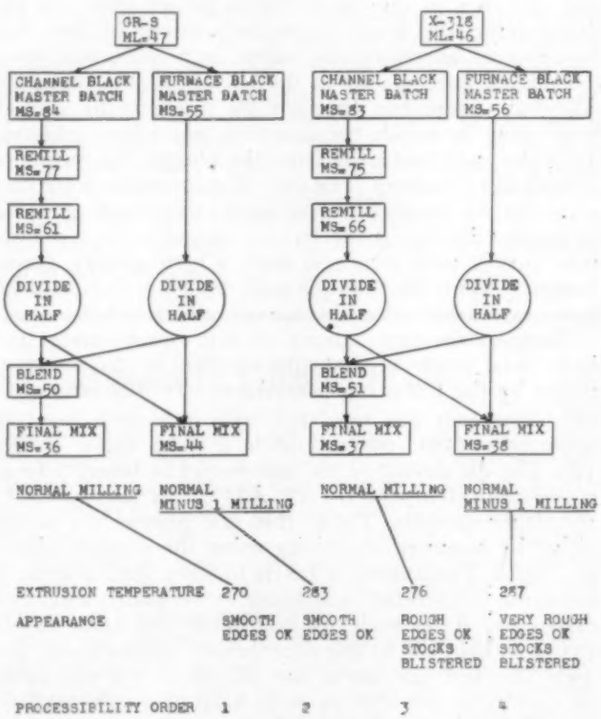

FIG. 14—Schematic diagram showing details of the procedure used in comparing two polymers for processibility by the factory method.

Note: The milling and mixing operations up to the point where the batches are divided in half are equivalent to the operation required to make the carbon black masterbatch indicated in Fig. 13. MS is equivalent to Mooney viscosity with the small rotor.

modification of the method proposed by White, Ebers, and Shriver *(2)* and was developed by the Government Evaluation Laboratories specifically to evaluate GR-S by means of the type of equipment existing in the synthetic rubber plants. This method employs the same sample and recipe used in making physical tests in accordance with the Specifications for Government Synthetic Rubbers *(18)*. Numerical values are assigned to mixing characteristics and to measurements that are made on the slab after removal from the mill *(3)*. An outline of the procedure used in determining a processibility index by this method is given below:

1. Mix the sample on a laboratory mill meeting the requirements of Section D-5-a of the Specifications for Government Synthetic Rubbers (*18*).
2. Band the GR-S on the front roll with a mill opening of 0.055 ± 0.005 inch. Start the stop watch as the raw material starts through the rolls. Report "time to band" in minutes required for the material to stay on the mill.
3. Mill the sample without cutting until it is free from holes, noting the time. Report the required time in minutes, including banding time, as "breakdown time."
4. Add the carbon black slowly, taking 12 minutes to add it, occasionally opening the mill to keep the bank constant. Sweep the pan, then cut the batch every ½ minute to 21½ minutes. Open the mill to 0.250 inch. Remove from the mill and cut two disks (weighing 37½ g.) for determination of viscosity, ML 212° F. at 4 min. The difference between this reading and the original reading is the "Carbon Black Stiffening."
5. Complete the batch in accordance with standard procedure. Set the mill opening at 0.100 inch, band the batch, and mill it for 1 minute. Roll the batch off, set the mill opening at 0.020 inch and pass the batch through the mill without banding. After 20 minutes of rest, make five measurements of "rugosity" on the surface that was against the front roll.
6. After 1 to 4 hours of rest, set the mill opening at 0.008 ± 0.002 inch and pass the stock through the mill twice without banding. Then band the stock at a mill setting which will result in the banded stock being 0.085 inch thick, and mill it for 1 minute, making six cuts. Stop the mill. Using a 4 x 6 inch template bent lengthwise to fit the contour of the mill, cut out a 4 x 6 inch sample. Lay it on a flat soapstone surface for four hours, then measure the length and calculate the shrinkage in per cent as follows:

$$\text{Shrinkage} = \frac{6 - X}{6} \text{ 100 per cent.}$$

Where X equals shrunken length in inches.

Calculate the "Processibility Rating" as the sum of the following five items, assigning a value of 4 to any item having a calculated value greater than 4:

(a) Actual banding time (when polymer bands on first pass assign a value of 0.1).
(b) Breakdown time divided by 2.
(c) Carbon black stiffening divided by 15.
(d) Mill shrinkage divided by 20.
(e) Rugosity divided by 35.

A comparison of results obtained on seven polymers evaluated for processibility by the laboratory mill method *(25)* and by the factory method *(17)* is shown in Table I and plotted in Fig. 15. From data obtained by the factory method, the polymers were rated from 1 to 7 in the order of their processibility with the difference between the extremes being about two remills. The lower the rating number the better the processibility. Reasonably good correlation exists between the processing index and the actual behavior in the factory for all but one of this particular group of polymers.

TABLE I—COMPARISON OF LABORATORY MILL METHOD PROCESSIBILITY WITH FACTORY RATING

Polymer	Factory Processibility Order	Banding Time (Min.)	Breakdown Time (Min.)	Mooney Viscosity ML 212° F. at 4 Min. Original	Mooney Viscosity ML 212° F. at 4 Min. With Carbon Black	Shrinkage	Rugosity	Processibility Index
BC40717C2	5	1	7	48	90.5	37	42	10.4
BC41017D2	6	1	6	52	97	38	68	10.8
BA50220B3	3	1	6	49.5	89	35	31	9.3
BC50319D2	7	1.5	8	51	96	38	50	11.8
BA50324B2	2	1	6	48	83	38	40	9.3
BC50503C1	4	1	6	48	85	37	41	9.6
BA50608A3	1	1	7	50.5	94	35	28	10.0

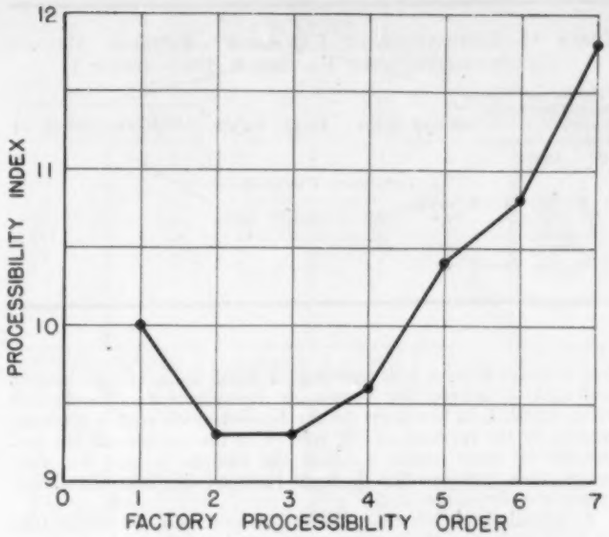

FIG. 15—Relation of laboratory mill method processibility index to factory rating.

The laboratory mill method has been found useful by the Government Evaluation Laboratories in research and development studies of new polymers whose processing characteristics vary markedly and of polymers taken from standard production from different plants. Work done at four different laboratories *(17, 25, 26, 27)* indicates, however, that the method has not yet been developed to the point where variation in processibility of the normal polymers produced by any one plant can be determined.

LABORATORY BANBURY METHOD: The laboratory Banbury method developed by the Goodyear Synthetic Rubber Corp. for evaluating processibility *(28)* is an outgrowth of the mill method developed by the Government Evaluation Laboratories. Through a series of experiments which were aimed at a study of reproducibility, selectivity, and correlation with factory work, it appeared that the tests which best satisfied these requirements were measurements of rugosity and shrinkage. It would be expected also from a knowledge of factory operations that these elements would have more to do with factory processibility than some of the others. The procedure for this method is as follows:

1. Pass the sample through a laboratory mill meeting the requirements of Section D-5-a of the Specifications for Government Synthetic Rubbers (*18*), three times with a mill opening of 0.085 inch.
2. Make a masterbatch containing 45 parts EPC carbon black and 6 parts Para-flux by mixing three minutes in a No. 00 Banbury with a shell water temperature of 150° F. and a worm speed of 65 rpm. Sheet the batch out on the mill with a mill opening of 0.250 inch.
3. Rest the batch overnight, then pass it through the mill with a mill opening of 0.085 inch. Remill it immediately for

TABLE II—COMPARISON OF LABORATORY BANBURY METHOD PROCESSIBILITY WITH FACTORY RATING—GROUP 1

Polymer or Viscosity-Conversion Ratio	GR-S-38	X-269	50/72	50/62	50/82	50/60-82	60/62
Factory Processibility Order	3	1	4	2	7	6	5
Laboratory Processibility							
A. Factory Mixed Stock							
Shrinkage	56.3	52.1	56.1	51.0	54.2	52.1	52.1
Rugosity	52	41	79	47	62	47	122
Index	55	48	64	50	57	50	75
Relative Rating	4	1	6	2	5	3	7

five minutes with a mill opening of 0.055 inch. Stop the mill and take a sample for shrinkage measurement. To do this make marks 6 inches apart on the bonded stock with a template bent to fit the contour of the roll. Cut the sample off the mill outside of these marks. Allow the sample to rest for four hours, then measure the distance between the marks and calculate the shrinkage in per cent.

4. Remill the batch on a laboratory mill with a mill opening of 0.055 inch, for three successive periods of five minutes each. Allow the batch to rest for at least one hour between remills. At the end of the third remill reduce the mill opening to 0.030 inch. Stop the mill and cut the stock off the mill. Allow the sample to rest four hours and then mark the sample in such a way that it is divided into three equal sections across the width. Obtain three readings of rugosity within each section and average all nine readings for the final result.

5. The "Processibility Index" is a weighted average of shrinkage and rugosity, giving shrinkage twice as much weight as is given to rugosity. Thus,

$$\frac{2\ (\text{Shrinkage}) + \text{Rugosity}}{3} = \text{Processibility Index}$$

Unlike the laboratory mill method, the specification mixing procedure is not followed in this method so that additional mixing is necessary in order to make the physical tests. The method, however, has the advantage that items 3, 4, and 5 can be applied to factory mixed stocks. It has not been definitely proved that the processibility index obtained in this manner is a definite reproducible quantity. In general, the method is probably better for determining relative ratings than for assigning quantitative values. If a control compound or polymer is used, fairly reliable relative ratings or processibility order numbers can be obtained.

As an example of the value of this method, the processibility indices determined for two groups of polymers are compared with factory order numbers of processibility in Tables II and III *(29)* and the laboratory processibility order versus factory processibility order is plotted in Fig. 16. Seven polymers were evaluated in the first group in factory mixed stocks and six in the second group in both laboratory and factory mixed stocks. Consequently, the processibility order numbers are from one to seven and one to six, respectively. The difference between the factory rating of one and seven amounts to somewhat more than one remill.

Correlation is far from perfect. On the other hand, the trend is quite definite, and there is no question, at least, about separating the extremes. From a study of curves 1 and 2, which might be considered as two independent attempts to correlate the results obtained on these polymers, it appears that the trend is the same in both cases, that the discrepancy between the two curves is fairly large but that the average of the two of them gives better correlation with the factory order than either one alone. It might be concluded from this that the properties which are being measured are the important ones but that the over-all experimental error is fairly large in comparison with the variations in polymers that are involved.

GOODYEAR LABORATORY EXTRUSION METHOD: Because of the frequent difficulty in interpreting viscosity and other simple test data used in predicting processibility, some prefer a more direct method based on the philosophy that if a polymer is to be processed in an extruder in the factory, the best method to demonstrate its behavior in the laboratory should be by the use of a laboratory extruder.

Evaluating rubbers for processibility by means of a laboratory extruder, however, is not as simple as it sounds. For example, rates of shear in a laboratory machine are likely to be different from those in a factory machine. The heating or cooling effect in a laboratory machine is much greater because of a higher ratio of metal surface to volume of stock. This method also has the distinct disadvantage that in its simplest form it is a relative test depending upon the operator's judgment and is not capable of yielding a quantitative value.

Of the extrusion methods that have been published previously, the Dillon *(10)*, Garvey *(11)*, and Vila *(30)* methods have a great deal of merit. However, the method to be described in detail here is of immediate interest, first because fairly reliable factory data are available and second because an attempt has been made to get supplementary numerical data which are independent of the operator.

The procedure in its simplest form is shown schematically in Fig. 17. The polymer is carefully sampled, and two batches of a black masterbatch are mixed. Half portions of each of the two batches are blended in the Banbury. (A given amount at such blending is called an X-mill.) Three samples are thus obtained, two of them half batches having had a single mix and one a batch having had a double mix. All three of these are then extruded in a laboratory extruder using a wide, straight tread-shaped die 1¼ inches wide and 3/32 inch thick at the center. A portion of the extruded stick is set aside for weight determination and the remainder is then extruded through a triangular die. A control polymer of known quality is always used

TABLE III—COMPARISON OF LABORATORY BANBURY METHOD PROCESSIBILITY WITH FACTORY RATING—GROUP 2

Polymer or Viscosity-Conversion Ratio	GR-S-38	X-269	50/72	40/72	60/72	40-60/72
Factory Processibility Order	3	2	4	1	6	5
Laboratory Processibility						
A. Factory Mixed Stock						
Shrinkage	49.0	47.9	50.0	52.1	49.0	58.8
Rugosity	28	24	32	26	140	40
Index	42	40	44	43	79	52
Relative Rating	2	1	4	3	6	5
B. Factory Stock after Extruding						
Shrinkage	47.9	44.8	44.8	45.8	42.7	49.0
Rugosity	24	24	24	25	40	38
Index	40	38	38	39	42	45
Relative Rating	4	1	1	3	5	6
C. Laboratory Banbury Stock (Average of Two Runs)						
Shrinkage	63.0	60.9	58.3	60.4	55.7	59.4
Rugosity	116	123	136	70	Rough	120
Index	81	83	85	64	...	80
Relative Rating	3	4	5	1	6	2
D. Laboratory Banbury Stock—Banbury Remilled						
Shrinkage	62.5	59.4	59.4	59.4	60.4	58.3
Rugosity	96	59	116	57	Rough	99
Index	74	59	78	59	...	72
Relative Rating	4	1	5	1	6	3

for comparison. Processibility is judged by the appearance of surfaces and edges, and is expressed as an order number in comparison with the control.

In an attempt to make the test more nearly objective the various quantities which could be measured during this procedure were studied. Only two seemed to correlate with factory processibility ratings. The first of these is called a "predicted viscosity" *(31)*. Its value is expressed as twice the Mooney viscosity of the compounded stock using the small rotor minus the original Mooney viscosity using the large rotor. A low value is an indication of good processibility.

The second property which seemed to correlate with factory processing is the weight of the extruded stock per unit length. High weight signifies good processibility. This value is converted to a scale that is compatible with the Mooney viscosity scale by means of a conversion chart *(31)* which is entirely empirical and which will suit only a particular compound, die, and extrusion machine. An average is then taken of the converted value and the "predicted viscosity." Finally, this average figure is converted to an objective numerical rating as indicated in the following outline of the procedure:

1. Sample five bales of polymer.
2. Obtain viscosity, ML 212° F. at 4 minutes, on each bale.
3. Make two masterbatch mixes in a No. 00 Banbury with a shell water temperature of 150° F. and a worm speed of 50 rpm. Use the following formula and mixing procedure for each batch:

FORMULA

Polymer (equal portions from each bale)	1900 g.
Carbon Black (EPC)	855 g.
Para-flux	114 g.
Total	2869 g.

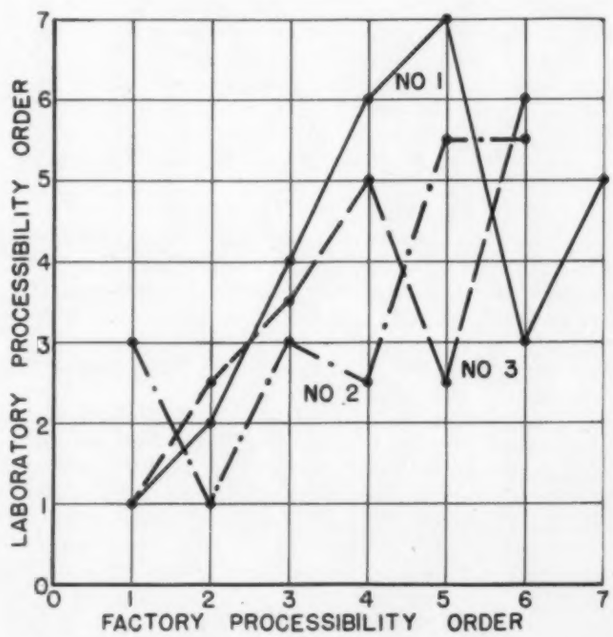

FIG. 16—Relation of laboratory Banbury method processibility rating to factory rating.
Curves: (1) Group 1, tests of factory mixed stock; (2) Group 2, tests of factory mixed stock; (3) Group 2, tests of laboratory mixed stock.

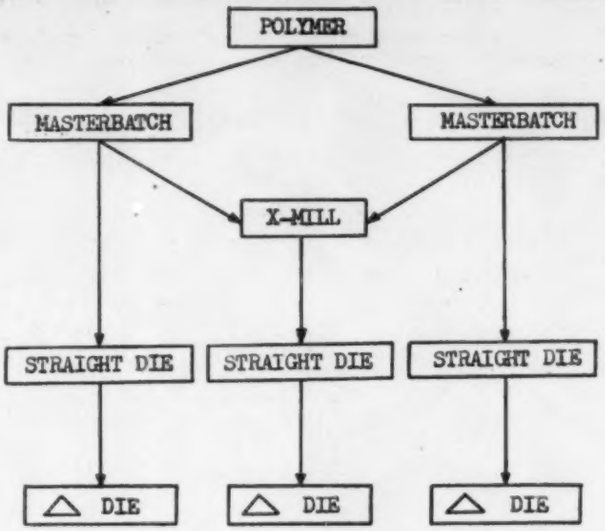

FIG. 17—Schematic diagram of the procedure of determining processibility by means of the Goodyear laboratory extrusion method.

MIXING OPERATION

Time	*Load*— *Order of Loading*
0-min.	(a) 25 per cent of polymer (b) all of carbon black (c) all of Para-flux (d) balance of polymer
3½-min.	Sweep
5-min.	Dump, and immediately sheet out the batch to a thickness of ¼-inch on a laboratory mill.

4. Take samples for determination of viscosity, MS 212° F. at 4 min., divide each batch in half and immediately extrude one half of each in accordance with the procedure given in item 6.

5. Allow the other half of each batch to rest for 24 hours, combine them and "X-mill" in a No. 00 Banbury with a shell water temperature of 150° F. and a worm speed of 50 rpm for 1¾ minutes. Sheet out the resulting batch to ¼-inch thickness as above. Take a sample for determination of viscosity, MS 212° F. at 4 min., and immediately extrude one half the batch in accordance with the procedure given in item 6.

6. Extrude approximately 1400 grams using the straight tread-shaped die. Three minutes after starting the extrusion operation cut out a sample from the extruded stick 15 to 18 inches long and allow to cool. Cut a 12-inch section from this sample in a miter box, weigh to the nearest 0.1 gram, and observe the appearance. Sheet out the remainder of the extruded stock to a thickness of ¼-inch and then immediately extrude it through the triangular die and observe the appearance.

7. From an examination of roughness, torn edges, etc., determine the visual rating of the sample in step 6.

8. Average the three values of Mooney viscosity of the compounded stock referred to in steps 4 and 5. Then compensate for rate of polymer breakdown using the equation

$$D = C - (M - C)$$

where D is a "predicted viscosity" after compounding,
C is average Mooney viscosity with the small rotor after compounding, and
M is original Mooney viscosity with the large rotor.

9. Using a conversion chart (not shown) determine W value from weight of extruded sample. The chart for the present equipment is a straight line connecting the (weight, W) points (55, 80) and (85, 23).

10. Average D and W. This gives the combined effect of viscosity, breakdown, and extruded weight:

$$A = \frac{D + W}{2}$$

11. Convert A to a numerical rating by means of a conversion chart (not shown) which is a straight line connecting the (A, rating) points of (10, 1) and (75, 9).

TABLE IV—COMPARISON OF GOODYEAR LABORATORY EXTRUSION METHOD PROCESSIBILITY WITH FACTORY RATING—GROUP 1

Polymer or Viscosity-Conversion Ratio	GR-S-38	X-269	50/72	50/62	50/82	50/60-82	60/62
Factory Processibility Order	3	1	4	2	7	6	5
Laboratory Visual Order (Average)	2.8	1.7	3.1	2.5	4.3	3.8	3.4
Viscosity Data							
Original (large rotor)	51	52	53	55	56	55	62
First test (small rotor)	53	47	53	53	62	56	60
Second test (small rotor)	51	46	54	52	60	56	61
Remill test (small rotor)	43	39	47	44	53	47	52
C	49	44	51	50	58	53	58
D	47	36	49	45	60	51	54
Weight Data							
First Mix	70.4	74.8	70.8	72.2	64.6	69.2	69.5
Second Mix	72.0	75.0	70.3	71.2	64.0	67.8	70.0
Remill	75.7	77.4	78.0	73.8	69.1	74.2	73.6
Average	72.7	75.7	73.0	72.4	65.9	70.4	71.0
W	43	38	43	44	58	48	47
Objective Rating	5.3	4.3	5.4	5.3	6.7	5.8	6.0

TABLE V—COMPARISON OF GOODYEAR LABORATORY EXTRUSION METHOD PROCESSIBILITY WITH FACTORY RATING—GROUP 2

Polymer or Viscosity-Conversion Ratio	GR-S-38	X-269	50/72	40/72	60/72	40-60/72
Factory Processibility Order	3	2	4	1	6	5
Laboratory Visual Order (Average)	3.1	2.3	3.9	2.5	5.6	3.8
Viscosity Data						
Original (large rotor)	48	48	51	39	67	52
First test (small rotor)	47	44	54	42	68	58
Second test (small rotor)	51	46	56	43	68	56
Remill test (small rotor)	41	39	46	36	58	46
C	46	43	52	40	65	53
D	44	38	53	41	63	54
Weight Data						
First Mix	70.0	74.5	70.7	73.8	61.8	69.6
Second Mix	71.6	74.6	71.3	74.1	63.7	68.4
Remill	77.3	80.3	76.9	82.1	70.4	76.8
Average	73.0	76.5	73.0	76.7	65.3	71.6
W	43	36	43	36	59	46
Objective Rating	5.1	4.3	5.6	4.5	7.3	5.9

As an example of the use of this method, two groups of polymers were evaluated in the factory and then subjected to this procedure to give both a visual and an objective rating of processibility *(31)*. The results are shown in Tables IV and V, and plotted in Fig. 18. It appears that the correlation of the visual ratings with factory processibility order is surprisingly good. The objective method appears to be slightly less reliable than the visual method.

Discussion and Conclusions

In this paper only the highlights of the important developments made in connection with controlling or evaluating characteristics of processibility have been presented. Perhaps before an evaluation can finally be depended upon, more standardization in the actual factory procedures will also be required since wide variations have been noted in factory processing of the same lot of rubber. For example, a lot of GR-I known to be exceptionally uniform was divided into two parts and used in a factory to make two lots of inner tubes. The number of rejects in one case was quite high while in the other it was quite low, indicating that the factory procedure was sufficiently variable to mask the uniformity of the rubber.

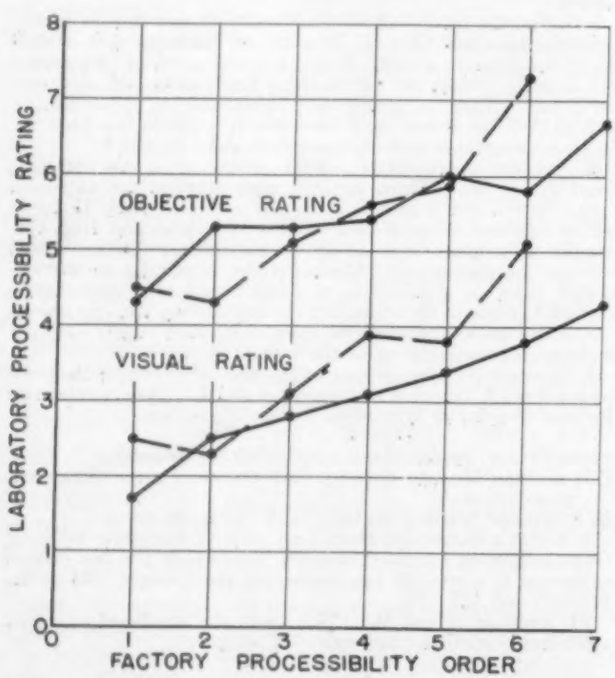

FIG. 18—Relation of Goodyear laboratory extrusion rating to factory rating. (Solid lines, Group 1; Dotted lines, Group 2).

This paper has placed more emphasis on the Mooney viscometer than on other methods, because most of the advancement in development and standardization has been accomplished with this instrument. In the absence of similarly extensive work with any of the other types of viscometer, or extensive measurements of correlation between them and the Mooney viscometer, it is impossible to say whether they would predict processing quality as well or better than the Mooney instrument.

In any case, it seems impossible that any type of viscosity test alone can be sufficient. To predict all aspects of processing behavior requires additional kinds of laboratory tests. The elastic recovery method reported here and the complete viscosity-time curve show promise, but have not yet been sufficiently correlated with the factory behavior of rubbers to justify conclusive statements.

It may be said, therefore, that considerable progress has been made toward establishing laboratory methods for determining the characteristics of rubber which are related to processibility. A great deal of development and standardization nevertheless still remains to be done before a complete and reliable evaluation of processibility can be made.

ACKNOWLEDGMENT

A considerable portion of the work reported in this paper is of necessity not original with the authors. Much of it was performed and reported to the Office of Rubber Reserve under the secrecy orders of the

(Continued on page 738)

HELPING MARK THE COURSE...

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Editorials . . . . . .

National Security

THE problem of the synthetic rubber plants and their eventual disposal continues to occupy the attention of the government and the industry. That some decision must be reached in the immediate future is recognized by all concerned, particularly because some form of permanent rubber legislation will be proposed to the next Congress as soon as it convenes after the first of the year.

The crux of the synthetic rubber plants problem is national security. All are in agreement that some set quantity of synthetic rubber must continue to be produced, and the consumption of that production assured. Never again should the United States be placed in a position where one of its vital raw materials is subject to being abruptly cut off. Never again should the domestic rubber manufacturing industry be subject to the ruinous fluctuations in the price of its base material.

Many solutions to the current problem have been offered, as reported from time to time in the pages of this journal. Another solution has been recently proposed by a chemical engineer who was closely associated with the synthetic rubber picture during the war, a solution which merits considerable attention. Alleging that this country actually has national security with respect to rubber, he argues that such security can be maintained with minimum quantities of both synthetic and natural rubber in government-controlled inventory and a single restriction in connection with the synthetic rubber production facilities.

The single restriction is that the entire synthetic rubber industry and facilities should be sold to private enterprise, and if no company is interested in buying such facilities the government should then maintain in standby condition, with no production, low cost petroleum-based plants with capacity equal to over 500,000 tons a year. Should the plants be sold to industry, the purchasers should be required either to guarantee a minimum production rate or to maintain the equipment in good standby condition. Should the purchaser later supplant the government facilities with new and better production facilities, he would still be required to guarantee minimum production.

This plan, according to its author, would accomplish two major objectives: (1) It would enable the United States to maintain national security by the standby plant arrangement and require no subsidy for synthetic rubber; (2) The existence of readily available facilities for synthetic rubber production would effectively keep the price of natural rubber in line.

The engineer in question has no fear with regard to the future of the synthetic product. He emphatically states that "it is foolhardy to assume that the use of a product will not increase continuously when its availability has been guaranteed by a process which gives low cost, absolute uniformity and freedom from violent price changes."

Test for Synthetic Rubber

THE latest revision of Rubber Order R-1, freeing natural rubber for use in all non-transportation items and natural latex in all items other than foamed products, curled animal hair and wire insulation, came as no surprise to the industry. Although the tire manufacturers fought hard to have the allowable natural rubber content in their products increased to 50 percent or better, it was recognized that they were fighting a losing battle, because government authorities are not yet willing to chance the possibility that in a completely free and open market the demand for synthetic rubber might drop below the national security safety zone.

In a sense the revised order represents the initial test in the eventual battle of natural versus synthetic rubber. It will be interesting to see how many manufacturers of non-transportation items change their present specifications to natural rubber and completely drop the use of synthetic. In another sense, however, the test is not quite fair, since natural rubber can be purchased for about 16c a pound against the mandatory 18½c a pound figure for GR-S. A fair and equitable test would provide both natural and synthetic products with the same market price. Government officials would do themselves a favor by immediately reducing the price of GR-S to 16½c a pound.

CURRENT NEWS OF THE MONTH

FREE USE OF NATURAL RUBBER FOR NON-TRANSPORTATION ITEMS

Although the official text of the order is not available at this writing (September 10), government controls over use of natural rubber in the manufacture of all non-transportation items have been eliminated in a sweeping revision of Rubber Order R-1, the gist of which was announced on September 5th by the Office of Materials Distribution of the Department of Commerce.

Use of synthetic rubbers will be concentrated in the transportation field, principally in tires and tubes, according to OMD officials, until Congress enacts legislation establishing a long-term national rubber policy. Synthetic rubber currently approximates 42% of consumption. The latest action was taken in line with the government's policy of rescinding the few remaining wartime controls as rapidly as supply conditions permit.

The new control formula will result in estimated consumption of the principal synthetic rubber, GR-S, at a rate of one-third of total GR-S and natural rubber processed. This is the ratio determined nearly two years ago by the Inter-Agency Policy Committee on Rubber to be adequate to support the synthetic rubber industry required for national security. Use in tubes of GR-I (Butyl), in amounts considered essential to national defense, also is provided for in the new orders.

Tire Specifications Unchanged

Tire specifications are unchanged by the new order. Popular size passenger car tires, 6.00 "load rating" cross-section and smaller, will continue to be manufactured with an over-all use of not more than 23 per cent natural rubber, as will industrial, implement and front farm tractor tires. Rear farm tractor and all other farm implement tires continue with a limit of 13 per cent natural rubber.

The larger sizes, 6.50 and up, of passenger and industrial tires will continue to rate not more than 67 per cent natural rubber. "Tolerances" permitted in these sizes, however, will be increased from 10 per cent to 20 per cent. This means that a manufacturer may turn out at least two grades of tire, containing different amounts of natural rubber, so long as his use of natural in his total production of these tires does not exceed the stipulated percentage. Airplane and inter-city bus tires, up to 11.00 cross section, may contain up to 94 per cent of natural rubber. Larger sizes are unrestricted.

Glen Named Acting Head

Earl W. Glen, who joined the Rubber Division of the former Civilian Production Administration in December, 1945, as assistant director in charge of technical operations, has been appointed Acting Chief of the Rubber Division of the Office of Materials Distribution of the Department of Commerce. He succeeds W. James Sears, recently resigned. A graduate of M.I.T., Mr. Glen was with Goodyear prior to entering government service.

All inventory restrictions are removed by the new order, as is the requirement for prior authorization to accept or consume natural rubber or natural rubber latex from any source. However, manufacturers who wish to purchase GR-S or GR-I will continue to make purchase requests to the Office of Rubber Reserve These changes eliminate a considerable volume of paper work, OMD said.

Other points in the new order of interest to manufacturers are:

(1) Increase to 2,000 pounds per quarter of the amount of natural rubber that may be used experimentally.

(2) Use of 100 pounds of natural latex per quarter for experimental purposes.

(3) Retention in large measure of current rubber end product import restrictions.

The revised order will allow import of any product, manufacture of which is permitted in this country, but will restrict import of any upon which specifications are imposed domestically.

Concentration of controls in the field of transportation items will greatly simplify administration of the order, officials said.

Insulation Report Available

A report of the Fifteenth Annual Meeting of the Conference on Electrical Insulation, sponsored by the Division of Engineering and Industrial Research of the National Research Council, Washington 25, D. C., has been issued by the Council. The report contains abstracts of the 38 papers presented at the meeting, covering the entire range of electrical insulation. Although meetings of the Conference are open to all persons interested in its work, the Annual Reports are furnished only to those who have paid the annual registration fee of $5.00 which was recently established to cover costs.

NEW LABOR AGREEMENTS SIGNED BY GOODYEAR AND GOODRICH

Agreements have been reached between the United Rubber Workers (CIO) and the Goodyear Tire & Rubber Co. and the B. F. Goodrich Co. on the latest demands presented by the rubber union. Both agreements call for new contracts granting six paid holidays in lieu of further pay boosts at this time. They also provide for reopening of the general wage scale on 60 days' notice, improved grievance procedure, and severance awards for long term workers. The Goodyear agreement was announced on August 17 and the Goodrich agreement on September 7.

Originally, the rubber union had asked for wage increases of an unspecified amount, equalling the increase in the cost of living since January 1, 1947, plus the difference between 11½c received from the "Big Four" last March and any other pattern of wage settlements in other industries.

The granting of six paid holidays brings the gains of the rubber workers in line with those won by other CIO mass-production unions. Six paid holidays means a rise of approximately 3½c an hour additional, making the total gain for this year about 15c.

Firestone Union Rebels

Members of the Firestone union have turned down the type of settlement negotiated with Goodyear and Goodrich. On August 20 the Firestone local presented a demand to the company calling for a 12-cent-an-hour increase. This was the first definite figure presented to any of the "Big Four" in the current negotiations. On September 7 members of the Firestone local voted to notify government agencies of a wage dispute. This action is expected to lead to the first use of the Taft-Hartley Act in the rubber industry.

No announcement has yet been made with regard to the negotiations currently being conducted between the union and the U. S. Rubber Co., although it is expected that the eventual agreement will closely follow those entered into by Goodyear and Goodrich.

The CIO union lost some ground in the rubber industry last month when the International Chemical Workers Union (AFL) won bargaining rights for some 1300 production employees of the Thermoid Rubber Co. at Trenton, N. J., defeating the United Rubber Workers which had represented the workers for a number of years. The vote was 606 to 484, with balloting being conducted by the National Labor Relations Board.

TIRE MANUFACTURERS ACCUSED OF PRICE-FIXING PRACTICES

A criminal complaint was filed on August 18 by the Department of Justice in the U. S. District Court of the Southern District of New York against eight tire manufacturers, ten company officials, and the Rubber Manufacturers Association. The defendants were accused of having conspired since 1935 to fix the prices of tires and tubes and to have determined other trade practices on a uniform basis.

The defendant companies, producing over 90% of all the tires and tubes made in the United States, are the Dayton Rubber Co., Firestone Tire & Rubber Co., General Tire & Rubber Co., B. F. Goodrich Co., Goodyear Tire & Rubber Co., Lee Rubber & Tire Corp., Seiberling Rubber Co., and the U. S. Rubber Co.

The ten individuals named included J. L. Cochrun (Seiberling), I. Eisbrouch (Dayton), George Flint (RMA), A. A. Garthwaite (Lee), H. N. Hawkes (U. S. Rubber), Lee R. Jackson (Firestone), L. A. McQueen (General Tire), J. J. Newman (Goodrich), A. L. Viles (RMA), and R. S. Wilson (Goodyear). Mr. Viles is president of the Rubber Manufacturers Association while Mr. Flint is chairman of the executive committee of the Tire Manufacturers Division of the Association.

Specific Charges Made

The complaint charged in general that the defendants "have held meetings and conferences within the Southern District of New York at which prices and policies pertaining to the distribution and sale of tires and tubes were discussed, formulated and agreed upon" and from time to time have communicated with one another orally and in writing to discuss and determine prices and price policies.

The effect of the alleged conspiracy, according to the complaint, has been to suppress competition unreasonably and to restrain interstate trade in violation of the Sherman Act.

Besides alleged uniform price agreements, the defendants are accused of having agreed on discounts, allowances and bonuses. Uniform warranties and adjustment policies were decided upon "for the purpose of eliminating price competition," the complaint says. Competition was curtailed further, it is charged, by the allocation of sales to agencies of the state, county and municipal governments, by agreeing not to produce certain types of tires and tubes and by agreeing on prices for slightly imperfect, obsolescent and slightly used tires and tubes.

The yearly production of tires and tubes immediately prior to January 1, 1942, averaged 50,000,000 tires and a like number of tubes valued at $1,000,000,000, according to the complaint. Since 1942 the productive capacity and income of the industry has more than doubled.

It is alleged that the investigation of the rubber industry began in March, 1946, and was prompted "by numerous complaints from independent tire dealers and others concerning the pricing practices of tire manufacturers." Evidence presented to the grand jury, it was stated, had shown "studied price-fixing practices by the industry to eliminate the public benefits of competition commencing in 1935."

It was further alleged that recent price cuts in tires and tubes had come fourteen months after the investigation started and "at a time when the investigation was making progress." The cuts occurred, it was noted, when a surplus of tires over demand had developed and some of the price reduction had been absorbed by a reduction in dealers' discounts.

"The suits should discourage agreements between the manufacturers to raise or stabilize tire prices with the result that prices to the independent tire dealers and the consumers will be on a competitive rather than an artificial level, even after surplus stocks are gone," an official said, adding that "in view of all of the evidence the Government could not consider the present prices as indicating that legal action should not be taken."

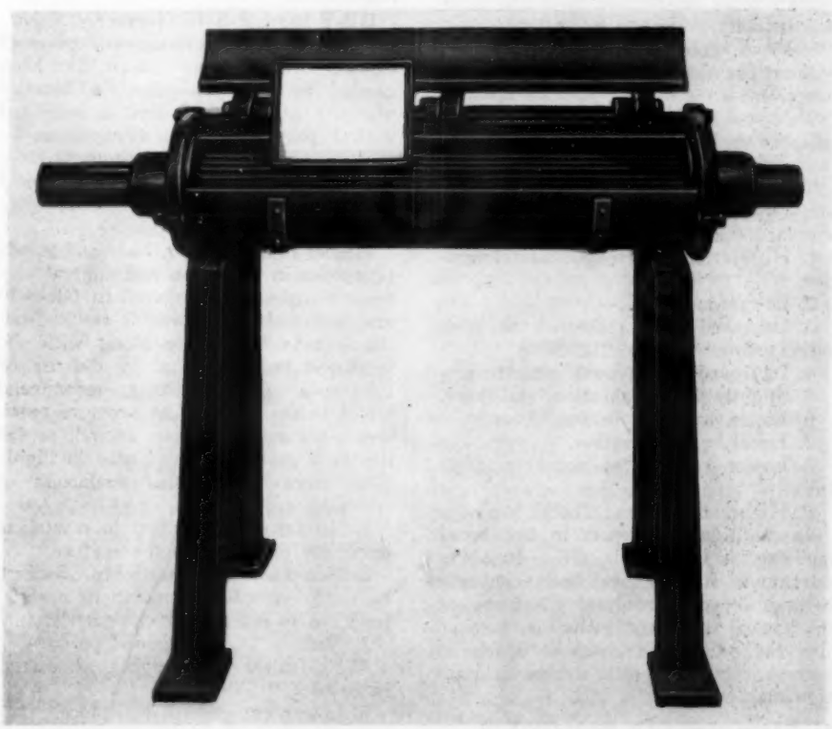
Executives of the various rubber companies named in the complaint were quick to defend their respective actions. Herbert E. Smith, president of the U. S. Rubber Co., called the action "incredible" and pointed out that the industry was presently supplying tires at prices comparable to those in the prewar period, despite tremendously increased manufacturing costs. He termed the automobile tire as "the world's best bargain today."

Thomas Expresses "Amazement"

E. J. Thomas, president of the Goodyear Tire & Rubber Co., expressed "total amazement" on the government's action, and promised that "we certainly are going to fight these charges to the limit." Mr. Thomas emphasized the fact that the rubber industry led all others in the effectiveness of its postwar contribution to national economy, and that it was in the vanguard of all American industry in increasing employment and raising wages.

William O'Neil, president of the General Tire & Rubber Co., stated that "it seems strange that the Department of Justice fires only verbal guns at industries putting price raises into effect but files criminal charges at one of the few industries cooperating whole-heartedly with the President's fight against inflation." He added that the complaint "just doesn't make sense and won't add up."

ORIGINAL HANCOCK MASTICATOR NOW IN SMITHSONIAN INSTITUTION



The original masticator for rubber devised and used by Thomas Hancock for more than 75 years is now on display at the Smithsonian Institution in Washington, D. C. The masticator, which bears the date 1840, is a gift from Sir Waldron Sinclair, managing director, and Alan Sinclair, director, of the British Tyre and Rubber Co. of London, and was made through the B. F. Goodrich Co. with which the British firm has been associated for many years.

SPECIAL PURPOSE "ROSIN SOAP" GR-S POLYMERS HAVING INCREASED TACK

A family of "rosin soap" GR-S type copolymers has been developed by the Office of Rubber Reserve, Reconstruction Finance Corporation. The specific properties of these polymers, beginning with the original type GR-S, as prepared by the Research and Development Division of the Office of Rubber Reserve, are enumerated below:

GR-S-10: GR-S-10 is a special purpose GR-S type copolymer of butadiene and styrene emulsified with a rosin soap, stabilized with 1½ parts of a standard rubber antioxidant and having a Mooney viscosity of 50 to 60. It is coagulated by the salt acid process.

The processing characteristics of GR-S-10 when compared to those of standard GR-S have been indicated to exhibit the following tendencies:

1. Improved tackiness for laminating and splicing.
2. Better ply-separation-resistance in carcass constructions.
3. Easier calendering and tackier fraction compounds.
4. Reduces building labor requirements.
5. Tendency to stick to calender or mill rolls which may be overcome by addition of a fatty acid or by blending with standard GR-S or GR-S-60 (formerly X-285-GR-S).
6. Better reinforcement and quicker dispersion of pigments.
7. Higher Mooney viscosity requires slightly more mastication to obtain same processibility.
8. More concentrated masterbatches without crumbling as a result of greater cohesiveness.
9. Slower curing rate which may be adjusted by increasing the acceleration ratio slightly.

The physical properties of GR-S-10 are reported to vary from those of standard GR-S as follows:

1. Higher tensile strength and elongation.
2. Lower modulus.
3. Improved tear resistance at both room temperature and 212° F.
4. Improved cut growth resistance.
5. Slightly better abrasion resistance.
6. Lower hardness in vulcanizates.
7. Equal heat generation.
8. Lower rebound at room temperature.
9. Higher rebound at 212°F.

In addition to its use in tire tread and carcass compounds, GR-S-10 offers advantages for soles and heels, conveyor belting, bicycle tires and all types of mechanical products including suction, fire and other type hoses in which its increased building tack during fabrication may be helpful.

Deviations from Basic GR-S-10

Deviations from basic GR-S-10 are listed and discussed in the following paragraphs:

X-352-GR-S: A lower Mooney GR-S-10 type polymer has been prepared experimentally as X-352-GR-S which has a Mooney range of 45 to 55. X-352-GR-S is expected to be easier processing than GR-S-10 and should require less mastication to obtain satisfactory breakdown and processibility. Its physical properties should be equivalent to GR-S-10, although it may exhibit slightly lower wear resistance and a possible improvement in flex crack growth.

GR-S-10AC: GR-S-10AC (formerly X-222-GR-S) is a special purpose GR-S which is made exactly the same as GR-S-10 except that coagulation is accomplished by the use of alum rather than by the salt acid method, which results in a slightly higher Mooney viscosity range (55 to 65). GR-S-10AC when compared to standard GR-S and GR-S-10 possesses a slower rate of cure which may be speeded up by an increase in accelerator ratio. At equivalent cures similar physical properties to GR-S-10 may be expected along with lower water absorption characteristics resulting from its low water soluble ash as well as improved viscosity stability.

Raw alum coagulated GR-S polymers in general do not oxidize as rapidly as GR-S-10 or standard GR-S and as a result undergo a smaller change in viscosity during mastication. Some users find that this fact provides more uniform viscosity and therefore consider alum coagulated GR-S polymers such as GR-S-10AC to have superior processing characteristics.

GR-S-16: GR-S-16 (formerly X-272-GR-S) is a special purpose copolymer of the GR-S-10 type which has been carried to high conversion, a Mooney viscosity of 100 ± 5 and is stabilized with 1 part of Stalite. Coagulation by the glue-acid technique imparts low water soluble ash and excellent electrical properties as the result of its low water absorption.

Higher reinforcement, body and tensile properties in high gum and mineral pigment compounds, compared to GR-S-10 and standard GR-S, which result from the increased viscosity along with the increased tack produced by the use of the rosin soap emulsifier, recommend GR-S-16 for transparent pressure sensitive tapes and adhesives, as well as for use as a more efficient binder in highly filled stocks. Additional tendencies of GR-S-16 are:

1. No fatty acid content to crystallize internally or bloom to the surface.
2. Non-discoloring tendency obtained by use of a reduced amount of a stabilizer low in discoloring characteristics.
3. Slightly higher rebound.
4. Equivalent heat aging characteristics to GR-S-10.
5. Lower cut growth resistance.
6. Slightly less soluble than GR-S and GR-S-10, but sufficient for normal processing.

GR-S-17: GR-S-17 (formerly X-273-GR-S) is a non-staining GR-S-10 type special purpose polymer stabilized with EFED. It is manufactured with a Mooney range of 50 to 60, especially for use in white and light colored compounds. It has physical properties similar to GR-S-10 and its freedom from discoloring and staining tendencies indicate advantages in light colored shoe soles, heels, mottled floor tile, electric lamp cord, and white sidewall tires. Several users have reported EFED polymers to be somewhat inferior in heat aging to standard GR-S, GR-S-10 or GR-S-50.

X-274-GR-S: A gel-free copolymer of the GR-S-10 type having a slightly higher Mooney viscosity range of 55-65 is manufactured as X-274-GR-S. It is relatively non-staining through the use of 1½ parts of Stalite as the stabilizer after polymerization. In physical properties X-274-GR-S is essentially equal to GR-S-10 in all respects. It appears to be superior to GR-S-10 in processing characteristics, particularly milling as judged by ease of banding, smoothness and freedom from sticking to the rolls. In addition, X-274-GR-S has been reported to be slightly more soluble than standard GR-S in standard solvents.

Additional information on GR-S-10 may be found in such recent articles as "GR-S Emulsified with Rosin Soap", by Cuthbertson, Coe, and Brady, *Industrial and Engineering Chemistry*, September, 1946, page 975; "Compounding of GR-S-10 for Tires" by J. G. Hendricks, *India Rubber World*, April 1946; and "Available GR-S Polymers" by J. L. Brady, *India Rubber World*, January, 1947, page 509; as well as in technical service bulletins issued by several chemical suppliers.

Use Cycleweld for Brake Linings

The Chrysler Corporation, Detroit, Mich., has announced that it is now using Cycleweld, the special cement developed during the war by the company in cooperation with the Goodyear Tire & Rubber Co., to bond brake linings to brake shoes in its automobiles and trucks. Use of the material is reported to increase braking area by 15 per cent. The conventional rivets used are completely eliminated with resulting safer, more economical and more pleasant driving, according to the company. With the rivets replaced by Cycleweld, the brake linings can now be worn down to their theoretical full depth, thereby giving one-third more service.

Swift Awards General Contracts

General contracts for construction of two buildings to be part of its new Technical Products Plant at Hammond, Indiana, have been awarded by Swift & Co., Chicago, Ill. Equipment for the manufacture of industrial oils will be installed in one of the buildings. The new plant will be the first of its kind in commercial production, according to Swift officials. It will process special oils for use in the rubber, textile, soap, cosmetic and other industries.

CHARGE BRAKE LINING MAKERS WITH ANTI-TRUST VIOLATIONS

Twenty manufacturers of replacement brake and clutch lining materials, who account for 96 per cent of the nation's production, were indicted on August 21 by a Federal grand jury on charges of violating anti-trust laws. They were named in three indictments along with fifty-three individuals and the Brake Lining Manufacturers Association of 370 Lexington Avenue.

The indictments, two involving domestic sales and one export sales, accused the defendants of a conspiracy to fix prices, trade discounts and other trade practices for the purpose of eliminating competition. The Brake Lining Manufacturers Association was declared to be the agency through which the defendants effected the alleged violations.

Attorney General Tom C. Clark said that the replacement friction material industry does a $45,000,000 annual business and that the pricing and other trade practices especially affect Federal and State Governments, municipalities and other large operators of automotive equipment.

Mr. Clark noted that because of the continued use of old vehicles, the replacement friction materials are an essential to highway safety. It was noted also that the defendants, through manipulated price and discount lifts, caused the materials to be sold abroad at prices cheaper than those in the United States.

John F. Sonnett, assistant Attorney General in charge of the Anti-trust Division, said that replacement brake linings are five times that of new equipment and added that the cases should "promote safety on the highways by enabling the public to purchase brake material at fair competitive prices."

Manufacturers Refute Charges

Vincent A. Spina, president of the Brake Lining Manufacturers Association, described as "preposterous" the assertion by Government officials that the anti-trust actions would promote highway safety.

"The brake lining and clutch facing business is one of the most intensely competitive businesses in the country," he asserted. "Profit margins are always narrow and, although since 1940 basic material costs have increased approximately 50 per cent and labor costs are up about 80 per cent, the prices for these materials have advanced on an average of 12 per cent, although the OPA itself authorized an increase of as high as 15 per cent."

Mr. Spina said that the manufacturer today receives about $2.50 for the brake lining and clutch facings used to reline the popular-make cars. Furthermore, he said, this brake lining which contributes so much to the public safety "is a vastly improved technological product over the pre-war product. Through expensive research and development a much more efficient product has been made available to motorists, affording greater public safety at a negligible advance in cost."

The corporations indicted include the following: American Brake Shoe Co., Asbestos Manufacturing Co., Bendix Aviation Corp., Fibre and Metal Products, Inc., Firestone Tire & Rubber Co., Gatke Corp., General Motors Corp., Grizzly Manufacturing Co., Johns-Manville Corp., Lasco Brake Products Corp., L. J. Miley Co., Pharis Tire & Rubber Co., Raybestos-Manhattan, Inc., Russell Manufacturing Co., Scandinavia Belting Co., Southern Friction Materials Corp., Thermoid Co., and the World Bestos Corp.

Coming Events

Sept. 27. Philadelphia Rubber Group, Philadelphia, Penna.
Sept. 27. Connecticut Rubber Group, Outing, Eichner's Grove, Trumbull, Conn.
Oct. 3. Boston Rubber Group, Hotel Somerset, Boston.
Oct. 7. Los Angeles Rubber Group, Mayfair Hotel, Los Angeles, Calif.
Oct. 9. Southern Ohio Rubber Group, Gem City Club, Dayton, Ohio.
Oct. 14. Buffalo Rubber Group, Hotel Sheraton, Buffalo, N. Y.
Oct. 16. Akron Rubber Group, Mayflower Hotel, Akron, Ohio.
Oct. 24. Detroit Rubber & Plastic Group, Detroit-Leland Hotel, Detroit Mich.
Oct. 24. New York Rubber Group, Hotel McAlpin, New York, N. Y.
Oct. 31. Chicago Rubber Group, Hotel Morrison, Chicago, Ill.
Dec. 5. Philadelphia Rubber Group, Kugler's Restaurant, Philadelphia, Penna.
Dec. 9. Buffalo Rubber Group, Hotel Sheridan, Buffalo, N. Y.
Dec. 12. Detroit Rubber & Plastic Group, Detroit-Leland Hotel, Detroit, Mich.
Dec. 12. New York Rubber Group, Xmas Party, Hotel McAlpin, New York, N. Y.
Dec. 12. Boston Rubber Group, Xmas Party, Hotel Somerset, Boston.
Dec. 18. Southern Ohio Rubber Group, Dayton, Ohio.
Dec. 19. Chicago Rubber Group, Xmas Party, Hotel Morrison, Chicago, Ill.

Additional Navy Specifications

Three additional specifications on rubber have been issued by the Bureau of Ships of the Navy Department since our last report. Copies of these specifications may be secured by addressing a request to the Navy Department, Bureau of Supplies and Accounts, Washington 25, D. C. The specifications follow:

Federal Spec. ZZ-H-496a—Pneumatic Braided Hose (April 24, 1947).

Bureau of Ships Spec. 52C15 (Ships) —Cement, for Attachment of Synthetic Rubber to Metal (June 15, 1947).

Bureau of Ships Spec. 33H12 (Ships) —Vacuum Hose (July 15, 1947).

REPORT ON RUBBER EMPLOYMENT INDICATES AN EARLY DECLINE

Based on reports from some 150 rubber manufacturing companies, the United States Employment Service recently reported that a decline in employment has been noted in the rubber field with further declines expected in the near future. An employment drop of 3,100 from April to May was reported by the companies furnishing statistics. The May total of 237,600 was 5,700 less than in March.

While declining, employment in the rubber industry is still nearly double the 1939 level, with sharpest postwar drops being recorded in Ohio, Massachusetts and Connecticut. According to the Department of Labor, two-thirds of any further reduction in the industry this fall will occur in Akron tire plants. Some lay-offs have already been reported in that area.

While general in scope, the decline thus far this year has been heaviest among companies making miscellaneous rubber products. Whereas such companies reported an employment decline of 3.6%, tire and rubber footwear companies reported declines of only 1.7 and 2.2%, respectively. Heaviest future declines are expected in the tire field because that field "is experiencing the transition from a seller's to a buyer's market."

The industry's greatest employment need, according to the U. S. Employment Service, is for women on light machine jobs producing miscellaneous rubber products, and as trainees and stitchers in rubber footwear production. Some skilled and semi-skilled workers, such as machinists, millmen, and mold and press operators, also are needed.

Bulk of the rubber industry's near future labor needs will be to replace those who quit voluntarily. These range from 2.2% in the tire field to 5% in the general molded goods field. If these quit rates continue, the 150-odd companies furnishing statistics for the survey indicated they would need some 8,000 replacements monthly. Most workers are said to quit for better jobs or because of poor housing or inadequate transportation.

The figures compiled by the Employment Service indicate that the rubber industry's labor force has become relatively stable. Women and war veterans each comprise about one-fourth of the total. Non-white workers constitute between 6 and 7%, an average that hasn't changed in six months. The proportion of women employed is expected to increase somewhat. Some 59,000 women were employed last May.

A new bulletin which contains technical information and detailed specifications on its complete line of one-piece flexible couplings has been made available by the Lord Manufacturing Co., Erie, Penna.

Sears Leaves OMD Rubber Division

Resignation of W. J. Sears, Chief of the Rubber Division of the Office of Materials Distribution, was announced on August 22 by H. B. McCoy, OMD Director. Mr. Sears entered Government service in July, 1941, with the Office of Production Management, and served continuously with OPM and its successor agencies, the War Production Board, Civilian Production Administration and OMD. In September, 1944, he became Assistant Director of WPB's Rubber Bureau. Under CPA, he was Director of that agency's Rubber Division and continued as division chief when CPA's few remaining functions were transferred to OMD.

Mr. McCoy praised the retiring official's work, saying "Mr. Sears has worked in close cooperation with the rubber industry, obtaining its advice and participation in the solution of many problems. Through his able leadership, he has brought to successful conclusion the reconversion from use of synthetic to natural rubbers, to the maximum degree compatible with national security. With the attainment of this goal, and since his intentions never were to make Government work his career, he considers his job finished."

Prior to the emergency period, Mr. Sears was employed by the United States Rubber Company. He was born in Columbus, Ohio, in 1913, and was educated at the Georgia School of Technology, Ohio State University, Wayne University and the Detroit College of Law.

Although Mr. Sears has given no indication of his future plans, there is a possibility that he may shortly join the Rubber Manufacturers Association in an executive capacity.

Offer Rubber Belting Cores

A new type of extruded core for wrapping rubber belting is reported to be finding favor with a number of rubber belt manufacturers, many of whom have already adopted the core. Made by Souhegan Mills, Inc., of Wilton, N. H., the cores are manufactured from sawdust and ground shavings mixed with a special type of resin, and are said to be a perfect substitute for wood cores. They have been successfully supplied in 5-inch, 6-inch and 10-inch diameters. Since the material is extruded endlessly, any required lengths can be furnished.

Completes New Laboratory

Completion of a new laboratory designed primarily for research leading to improving the qualities of synthetic rubber products has been announced by the Adhesive Products Corp., 1660 Boone Ave., New York 60, N. Y. The new laboratory will be under the direction of Dr. Benton Dales, formerly in charge of the Neoprene Latex Laboratories of E. I. du Pont de Nemours & Co., with whom he was associated for the past fifteen years.

Lightbown Advanced by Enjay

Irving E. Lightbown

Irving E. Lightbown, assistant manager of rubber sales of the Enjay Co., Inc., formerly known as Stanco Distributors, Inc., since February 1, 1942, has been advanced to manager of rubber sales of that company. The Enjay Co., Inc., is an affiliate of the Standard Oil Co. of N. J., with offices at 26 Broadway, New York, N. Y. Mr. Lightbown has been with Enjay or other Standard Oil affiliates since 1937. Born in Fall River, Mass., Mr. Lightbown was graduated from Cornell University in 1931 with the degree of Bachelor of Chemistry. Before joining the Esso Laboratories as a chemist in 1937, he was affiliated with the B. F. Goodrich Co. in Akron and the General Cable Co. in Buffalo, N. Y. He is a member of the American Chemical Society and its Division of Rubber Chemistry, as well as of the New York Rubber Group. He is also a member of the New York Chemists' Club. Mr. Lightbown is married and has three children.

Two Join Moldex Rubber Corp.

Herman Encke, formerly associated with the Norwalk Tire & Rubber Co., and Richard P. Ryan, formerly with the Aetna Rubber Co., have joined the Moldex Rubber & Plastics Corporation as factory manager and chief chemist, respectively. Both men will be stationed at the factory, 430 East Allegheny Ave., Philadelphia 34, Penna. L. K. Braunston is president and A. A Mayers is vice-president of the company, which makes its headquarters at 1 East 57th St., New York 22, N. Y.

U. S. Leases Norwalk Plant

U. S. Rubber Company has leased a three-story factory building at 15 Merwin St., Norwalk, Conn. The building, which contains some 26,000 square feet of floor space, will be altered before being occupied by the Electroforming Division of the company. O. R. Huggins has been named manager of the plant.

Develop Bloom Inhibitor

A new bloom inhibitor, NATAC, which has wide application in natural rubber and mixtures of natural rubber and GR-S has been developed by the research laboratories of J. M. Huber Corporation, New York. The new material is a modified resin acid which has inherent tack and is neutral with thiazole acceleration in natural rubber. Two to four parts of NATAC per 100 rubber hydrocarbon will retard fatty acid and sulfur blooms and impart a lasting tacky surface to products in which it is compounded. Tire coat and friction stocks, tire repair materials, laminated mechanical parts, footwear friction, gum parts and similar rubber compounds may be worked longer with reduced blooming tendencies usually caused by cold weather, lay-over, rapid chilling, etc. NATAC may be safely added to present compounds or used in place of other softeners without affecting the physical properties of the cured stocks. It is a solid with a melting point (Ball & Ring) of 145° to 155° F., shatters readily at room temperature, and requires no previous melting before adding to the batch. Its specific gravity is 1.082.

Open-End V-Belting Reels

Plant engineers and other users now can buy open-end V-belting by the foot or yard in much the same manner as their wives purchase ribbon and dry goods. This method of merchandising V-belt material is announced by Goodyear Tire & Rubber Co., which is supplying the belting in reels of 450 to 550-foot lengths, according to H. D. Foster, manager of the company's Mechanical Goods Division. Using special fasteners to splice the open ends, making an endless power-transmission belt, the V-belts thus can be formed to proper size for emergency use and special adaption. The fasteners are installed with specially-designed tools. Goodyear is supplying open-end V-belting in standard top widths of 21 thirty-seconds, seven-eighths, and one and a quarter inches. The belt carcass comprises multiple layers of heavy, cross-woven fabric, designed for high power capacity and fastener-holding security. The protective cover was specially developed for maximum flexibility and external wear.

Correction

An article describing and illustrating the DuPont Type Scrub Tester, manufactured by the Keefe Machine Co., Framingham, Mass., appeared in the New Equipment Section of our May, 1947, issue. Only a limited number of these machines were produced by the Keefe concern on a custom basis to make possible evaluation tests by members of various A.S.T.M. committees. The Keefe Machine Co. wishes to correct any possible implication of the general sale of the scrub tester without permission of the DuPont Company.

MALAYAN RUBBER PRODUCTION IS REACHING RECORD LEVELS

Rubber production in British Malaya has recovered more rapidly since the end of the war than was generally expected. According to an article in the August 23, 1947, issue of *Foreign Commerce Weekly*, official publication of the U. S. Department of Agriculture, production of natural rubber during the first six months of this year totaled 310,859 long tons, the second best six-month output on record.

British Malaya accounted for over 50 percent of world production of rubber in the six months to make the area more important in the world's rubber trade than ever before, the article states. Production throughout the elapsed period of this year has been augmented by flush yields from trees rested during the period of Japanese occupation, according to the article.

The task of rehabilitating the rubber industry of British Malaya after the Japanese were driven out was great and quick recovery seemed unlikely. Plantations were overgrown with weeds, many trees were destroyed by the Japanese and others were in poor condition after almost four years of neglect. Buildings were destroyed, installations were wrecked or vital parts stolen and labor was dispersed.

Owners of small plantations which provide their own labor and required only a minimum of equipment managed to improvise needed coagulants or purchased them in the black market. Production was thus started quickly and the rate of output accelerated throughout 1946. Rubber estates of 100 acres or larger necessarily started producing more slowly than the small holdings but their production has mounted steadily and totaled 165,151 tons in the first six months of this year.

William N. Small, Rubber Section, Office of International Trade, author of the article, states that in the absence of any retarding factors, Malayan production, imports and exports of natural rubber will establish all-time new annual records in 1947.

Southern Ohio Completes Program

The program for the next meeting of the Southern Ohio Rubber Group, which will be held on October 9 at the Gem City Club, 121 So. Ludlow St., Dayton, Ohio, rather than September 18 as originally announced, has been completed. It will feature a talk on "Molds as Applied to Rubber and Plastics" by H. O. Poock, chief tool engineer of the Inland Manufacturing Division of the General Motors Corp. A question forum is planned to follow presentation of this talk, and members and guests are invited to bring their mold problems to the meeting. The sound motion picture depicting the East St. Louis, Ill., plant of the Midwest Rubber Reclaiming Co. will also be shown.

Rubber Mounted Plane Cabin

A new long-range airplane, which was recently put into service from New York to Paris by Air France, has an air-conditioned cabin suspended in rubber mounts to eliminate vibration. The plane, called the Constellation 749, can seat forty-eight passengers and is powered by four 2,500 horsepower engines, giving it a cruising speed of 328 miles an hour. Eight planes of similar construction have been ordered by Air France.

Akron Names Meeting Dates

Official meeting dates of the Akron Rubber Group for the 1947-48 season have been announced as October 16, 1947, and February 6, April 16 and June 18, 1948. Chairmen of various committees have been selected, as follows: *Program*, Robert H. Crossley (Caldwell); *Membership and Attendance*, Robert W. Mitten (Enjay); *Tickets*, Roy H. Marston (Binney & Smith); *Publicity*, John M. Pittenger (*India Rubber World*). Roy M. Vance (General Tire) is chairman of the group, Henry F. Palmer, vice-chairman, and C. A. Ritchie (Goodrich), secretary-treasurer.

Speakers for Boston Meeting

The meeting of the Boston Rubber Group at the Somerset Hotel in Boston, Mass., on Friday, October 3, will feature two speakers. Dr. Henry F. Palmer, associated with the Firestone Tire & Rubber Co. for some twenty-five years, and now acting as an independent consultant, will deliver an address on "Some Facts and Views on Reclaimed Rubber," while Denny Meyers, head coach of the Boston College football team, will talk on "Interesting Football Stories." Bernard H. Capen, of the Tyer Rubber Co., Andover, Mass., is secretary-treasurer of the group.

Philadelphia Meets December 5

The next meeting of the Philadelphia Rubber Group will be held on December 5 at Kugler's Restaurant in Philadelphia, Penna. F. W. Sands, of the New York office of the U. S. Rubber Co., will speak on "The Rubber Chemist and Health Protection." The talk will also cover plant health hazards.

Detroit Sets Future Meetings

The last two meetings this year of the Detroit Rubber & Plastics Group, Inc., will be held on October 24 and December 12. As in the past, these meetings will be held at the Detroit-Leland Hotel in Detroit, Mich. The December 12th meeting will be the Annual Christmas Party.

R.M.A. REPORTS ON CONSUMPTION FOR FIRST SIX MONTHS OF 1947

Consumption of all types of crude rubber in the first six months of the current year by American rubber manufacturers totalled 571,774 long tons, according to the latest report of the Rubber Manufacturers Association. This represents a 15.74% increase over the 494,018 long tons consumed in the first six months of 1946. Consumption in the full year of 1946 amounted to 1,039,000 tons, the all-time annual high.

Of the 571,774 long tons consumed in the first six months of this year, 258,792 tons were natural rubber and 312,982 tons synthetic rubber. The synthetic rubber total was made up of the following types: GR-S, 251,143 tons; Butyl, 38,464 tons; neoprene, 21,031 tons; nitrile rubbers, 2,344 tons. In addition, a total of 147,593 long tons of reclaimed rubber were consumed, representing a gain of 12.59% over the 131,091 tons consumed in the 1946 six-month period.

Consumption in the month of June, 1947, was actually down from the preceding month, the figures beginning to reflect the normal seasonal decline in manufacturing activity during the summer months which are marked by inventory taking and plant vacations. In June, manufacturers used 84,899 long tons of crude rubber, a decline of 7.43% from the 91,710 (revised) tons consumed in May. June consumption consisted of 42,541 long tons of natural rubber and 42,358 tons of synthetic. Reclaimed rubber consumption in June amounted to 21,263 tons.

Name Plastics Division Personnel

Several additions have been made to the personnel of the new plastics division of the B. F. Goodrich Co. at Marietta, Ohio. Adolph H. Thye, formerly staff manager in the company's reclaimed rubber division and later in the plastics division at Akron, has been appointed as staff manager. V. F. Wigal, associated with the company since 1939, principally in its processing division, will be in charge of the chemical laboratory. Robert A. Mansfield, with the company since 1940, will be in charge of customer service and product development. Joseph J. Devlin, formerly a buyer of cotton and rayon goods for the company, has been named purchasing agent.

Order Jap Plants Destroyed

The eleven-nation Far Eastern Commission on September 3 ordered General Douglas MacArthur to destroy all Japanese buildings, machinery and equipment which could be used in the production of war materials. All other primary war facilities which have some peacetime value were ordered impounded and their machinery and equipment made available for reparations. The Japanese synthetic rubber plants were specifically marked for destruction.

1946 TIRE DISTRIBUTION STUDY INDICATES DEALER POSITIONS

Independent tire dealers handled 51.8% of the nation's passenger tire replacement business and 60% of truck tire sales in 1946, according to the latest survey of tire distribution conducted by Dr. Warren W. Leigh, head of the Commerce Department of the University of Akron. The survey was the first made since before the war.

The greatest sales gain, however, according to the survey, was made by the oil companies. These firms sold twice as many tires in 1946 as they did in 1941, the figures being 19.1% as compared with 15.5%. Although chain stores and mail order houses sold 1,500,000 more tires in 1946, their percentage figure dropped from 24 to 17.

Company-owned stores, totalling 1,927, most of them operated by Firestone, Goodrich and Goodyear, increased their tire sales last year although the number of stores declined. They did 9.4% of all tire business in 1946 as compared with 8.8% in 1941. Private brand tire sales advanced about 44% over 1941, but declined in proportion to total sales of all tires. These tires represented 29% of all replacement sales made.

The survey indicated that the independents sold 33,991,000 units in 1946 as compared with 19,221,000 units in 1941. Cooperatives sold approximately 700,000 tires in 1946, or 1.1% of total sales. The significance of these outlets for tire sales has been steadily increasing.

According to the survey, total tire sales in 1946 amounted to 82,000,000 units, an increase of some 16,000,000 over 1941. Of this total, approximately 65,490,000 were in the replacement sales field, the field covered by the survey.

Organizes New Selling Concern

Julius Tumpeer, one of the founders of Wishnick-Tumpeer, Inc., now known as the Witco Chemical Co., and a vice-president for many years, has left that company and has organized the Tumpeer Chemical Co., with offices at 333 North Michigan Ave., Chicago 1, Ill. The new company will act as sales agents for rubber compounding and other materials, including carbon black, pine tar, etc. Further information concerning the specific materials to be handled and selling arrangements will be announced in the near future.

Naugatuck Technical Bulletins

The Naugatuck Chemical Division of United States Rubber Co., 1230 Avenue of the Americas, New York 20, N. Y., recently made available three new compounding research reports. These are: (1) B-L-E 25, (2) Flexamine, A Superflexing Antioxidant, and (3) Aminox in Natural Rubber Non-Black Passenger Inner Tubes. Copies of these technical bulletins are available on request to the company.

Age of Malayan Trees

According to a recent report, approximately 70% of the rubber trees in Malaya, as of December, 1946, were over 21 years of age, with only 12.7% of the total acreage planted with high-yielding trees. The producing life of a tree is believed to be as high as 50 years, but experts agree that the best years are from 13 to 17, after which a progressive decline sets in.

Goodyear Plans Gigantic Expansion

One of the larger war plants on the outskirts of Akron, operated by the Goodyear Aircraft Corporation during the war for the production of fighter and bomber planes, has been purchased by the Goodyear Tire & Rubber Co. The main structure and 12 affiliated buildings embrace 864,000 square feet of floor space, and are spread over 35.8 acres. The plant will be used for the expansion of production facilities for Pliofilm and Airfoam and will be known as the Special Products Manufacturing Division. More than $9,000,000 will be spent by the company in placing the plant in its peacetime operation, of which $2,200,000 represents the sum paid to the War Assets Administration for the structure. Production is expected to start early in 1948, with some 1,200 persons employed. The decision to locate its expanded Pliofilm and Airfoam activities at the one-time aircraft plant centralizes production activities for the Chemical Products Division of the company. A section of another plant, purchased from the WAA last year, now houses preliminary operations on Goodyear's newest product, a vinyl material.

M.I.T. Offers Silicon Course

Establishment of a course in the colloid chemistry of silicon at the Massachusetts Institute of Technology, Cambridge, Mass., has been announced. The new course, which will begin this fall under the direction of Dr. Ernst A. Hauser, associate professor of chemical engineering, will be a survey of the chemical and physical properties of substances containing silicon as their basic constituent in correlation with their molecular structure.

Traflet Heads Pequanoc Rubber

Frederick E. Traflet, formerly vice-president of the Pequanoc Rubber Co., manufacturers of reclaimed rubber of Butler, N. J., has been elected president, succeeding the late Joseph F. McLean. Other new officers include Thos. N. D. Mace, vice president; Miss M. T. Gunter, secretary-treasurer, and Newton H. Tuthill, assistant treasurer.

ROLE PLAYED BY CHEMNYCO FIRM REVEALED BY FARBEN PROSECUTOR

Complete reports on the progress made by American firms in connection with their synthetic rubber experiments were transmitted to I. G. Farbenindustrie by officials of Chemnyco, Inc., in the years just prior to the war. Documents to this effect will be introduced during the current trial of twenty-four Farben officials before an American tribunal in Germany. They are charged with helping to build the Nazi war machine.

One document is a memorandum by H. Beller, official of Chemnyco, Inc., of New York, detailing experiments being made in the laboratories of Goodyear, Firestone, Goodrich, U. S. Rubber and General Tire and Rubber companies. The memorandum dated November 20, 1939, was prepared after Mr. Beller visited the firms. It was forwarded to Farben.

Chemynco was organized by Americans who were relatives of Farben officials. Under its agreement with the German trust it supplied Farbenindustrie with "memoranda of financial and industrial conditions in the United States and information as to business developments of American corporations together with other statistical information." It also facilitated the visits of German industrialists to the United States.

"The result is that Farben sent over droves of technicians to America," Mary Kauffman of New York, a prosecution staff member, said. "There the technicians would visit American plants and then return and make reports to Farben in Germany. Of course Farben was tied in so closely with the Nazi government that such information was then turned over to German army intelligence."

No. 715 Rubbagrip Cement

A new adhesive, said to answer the need for a cement versatile enough to be used with effectiveness in adhering vinyl and other plastics, as well as rubber, metal, glass, leather, wood, and sponge to themselves and other materials, has been introduced by Rubba, Inc., 1015 East 173rd St., New York, N. Y. Called No. 715 Rubbagrip, the new cement is reported to resist extremes of heat and cold, and is not affected by acid, alkali, oil or water. It remains flexible and since it is a cold-setting adhesive it requires neither catalysts or heat in its application.

To Sell Oxygenated Chemicals

A long-term contract has been announced between U. S. Industrial Chemicals, Inc., and Stanolind Oil & Gas Co. for the sale by U.S.I. of all water-soluble oxygenated chemicals to be produced at the first two synthetic gasoline and oil plants using the much-publicized Fischer-Tropsch process. The plants are being undertaken by Stanolind, a subsidiary of the Standard Oil Co. of Indiana, and the Carthage Hydrocol Corp.

Developments to Be Featured

Post-war progress in the chemically controlled industries will be a significant feature that will be reflected in the exhibits at the 21st Exposition of Chemical Industries at Grand Central Palace, New York, December 1-6. News from exhibitors indicates a marked trend in the development of materials and units of all types designed to meet extremely difficult operating conditions, notably in the way of very high pressures and temperatures, and powerful corrosive effects. This would indicate a consensus that many industrialists are considering ventures into new fields where intensive requirements predominate, bespeaking new demands on equipment. The exposition will be one of the largest of its kind ever held, with an unusual variety of displays including industrial chemicals, chemical products, industrial materials and supplies of many kinds, in addition to the wide range of equipment specifically designed for the process industries. The roster of exhibits already accounts for all available exhibition space on the four floors of the Palace.

Swan Occupies New Extensions

The Swan Rubber Company moved into its new factory wing at Bucyrus, Ohio, within recent weeks. The new wing at Bucyrus adds 76,000 square feet to the plant, making a total of 156,000 square feet of floor space. At the same time a new wing was opened at the plant operated by the company at Carey, Ohio, adding 35,000 square feet of space to that plant. Opening of the new wing at Bucyrus is expected to boost employment at that plant to over 600. New equipment valued at more than $500,000 is installed in the new wing, including one of the three largest lead presses in the country. Two new 84-inch mills have also been installed. Believed to be the largest manufacturers of garden and heater hose in the world, the company is now producing 120,000 feet of hose every 24 hours. M. G. Nussbaum is president of the company.

Additional Barrett Reports

Two additional technical reports in its current series of bulletins on its rubber compounding materials have been issued by the Barrett Division, Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y. Laboratory Release No. 4 presents data on BRS 700, a new softener and extender of the solvent and swelling type which is said to confer good hysteretic properties, improve processing, calendering and tubing properties, and also improve resistance to tear and crack-growth. Laboratory Release No. 5 offers compounding information on the behavior of the M.S., R.H., and M.H. grades of Cumar in GR-S-channel black stocks and the effect of Bardex and BRH No. 2 in GR-S stocks. Copies of the reports are available from the company on request.

Bell Joins Thermoid Rubber

M. R. Bell

Appointment of M. R. Bell as assistant rubber production manager for the Thermoid Company has been announced by Fred Schluter, president of the company. Mr. Bell, who brings to his position many years of experience in the engineering field, becomes assistant to Lester F. Cox, vice-president for production for the Trenton company. A native of Chicago, Mr. Bell attended schools there, and was graduated with the degree of mechanical engineer from the Case School of Applied Science in Cleveland. After several years in plastic development work with the National Carbon Company, Vinylite Division, Cleveland, he became associated with the Aeronautical Division, B. F. Goodrich Company, on the correlation of designs for aircraft components. He spent four years in war production as plant manager for the Aeronautical Division of the Pharis Tire and Rubber Company in Parkersburg, West Virginia. More recently he has been engaged in consulting and design and has also been active in the widely expanding labor relations field.

Seiberling has developed a new type of black rubber heel which is said not to mark any floor surface. Known as Kantmark, the heel is made in all sizes of a smearproof black rubber composition.

Production of its puncture-sealing inner tube, which contains plastic rubber inside the crown to surround puncturing objects, has been resumed by U. S. Rubber.

A giant electrical transformer has been installed at the new Goodrich plastics processing plant at Marietta, Ohio. Known as a three-phase transformer, it weighs 103,600 pounds and contains 6,500 gallons of special oil weighing 49,000 pounds.

To Produce Rubber Chemicals

The Golden Bear Oil Co., whose headquarters are at 325 West 8th St., Los Angeles 14, Calif., and refinery and laboratories at Oildale, Calif., is entering the field of rubber chemicals in its newly-created Chemicals Division. The principal aim of this new division is to serve the western rubber industry with high quality products in the line of high boiling hydrocarbons and derivatives. Dr. Fritz S. Rostler, who has resigned his position as Research Professor of Chemistry in the Engineering Experiment Station at the University of Delaware, has been named Director of Research and Development of the new Chemicals Division. He will be assisted by Richard M. White, who has acted as his technical laboratory assistant for a number of years. The Golden Bear Oil Co. is said to be the only independent western oil company with its own wells of Poso type crude. The company's research facilities are being reorganized and expanded and will include a modern rubber testing laboratory.

Plastofries 62 Plasticizer

Plastofries 62, a new plasticizer for polyvinyl chloride, the vinyl copolymers, cellulose acetate, cellulose actetobutyrate, nitrocellulose, and other resins and elastomers, has been introduced by the Scheer Chemical Co., Inc., 60 East 42nd St., New York 17, N. Y. The new material is reported to be characterized by excellent thermal and ultra-violet stability, non-inflammability, non-volatility, and unusual electrical properties. It has a melting point of 25° C., boiling point of 220° C. at 10 mm.; specific gravity of 1.369 at 25°/4°, and weighs 11.5 pounds per gallon. Because of its non-inflammability, Plastofries 62 is of considerable interest as a plasticizer for nitrocellulose in the fabric coating industry. It is compatible with cellulose acetate and acetobutyrate and is suggested as a plasticizer for use in molding powders based on these cellulose esters.

Cotton and Synthetic Cord Tests

In recent road tests conducted by the National Cotton Council, Memphis, Tenn., truck tires made with cotton cord were found to give approximately twice the mileage of tires using synthetic cord, with one cotton cord tire outlasting three recappings and 100,000 miles of service. Among twelve tires using four different kinds of fabrics, of which three were cotton and one rayon standard, average mileages were 46,399, 50,673 and 50,975 miles for cotton cord tires, and 25,985 miles for rayon cord tires. All of the tires tested were made of 70% synthetic and 30% natural rubber, and were manufactured under identical conditions in identical molds. The tests conducted were said to be among the few road tests which have been made in which all specifications were the same for all tires except for the fabric.

NAMES IN THE NEWS

E. WAYNE HALEY, associated with the Southern Alkali Corp. for the past 12 years as assistant director of sales, has been appointed director of sales of that organization, succeeding ELI WINKLER, who will continue with the firm in the capacity of sales consultant.

E. W. SANDERS, associated with the Goodyear Tire & Rubber Co. since 1928, most recently as sales manager of the rubber-to-metal products division, has left that organization to join the Wilsolite Corporation, Buffalo, N. Y., as vice-president and sales manager.

RAYMOND J. HULL, a former production manager in the tire division of the B. F. Goodrich Co. at Akron, has been named factory manager of the company's new tire plant now being constructed in the Netherlands.

R. A. BONDURANT, JR., technical director of the Michigan Chemical Corp., St. Louis, Mich., since 1943, has been elected a vice-president of the company.

C. E. MACADOO has replaced H. G. Ross as purchasing agent at the Point Breeze (Baltimore) Plant of the Western Electric Co., and FRED WEISS, JR., has replaced E. A. HOEPPENSTADT as buyer of chemicals at the same plant. MR. ROSS is now located at the company's headquarters in New York City as buyer of rubber.

DR. G. F. D'ALELIO, formerly manager of the High Polymer Research Laboratory of the Industrial Rayon Corporation at Cleveland, has joined the Koppers Co., Inc., Pittsburgh, Penna., as an assistant director of research.

ROBERT E. THOMAS, associated with the International Latex Corp. for the past two years, and formerly with the Miller Rubber Division of the B. F. Goodrich Co., has joined the Midwest Rubber Co., Detroit, as chief chemist and factory superintendent.

LARRY H. COFFIN, who has been plant manager of the company's tire, textile and mechanical goods operations in Sao Paulo, Brazil, since 1942, has returned to the Akron offices of the Goodyear Tire & Rubber Co. as assistant to GEORGE K. HINSHAW, vice-president and production manager of foreign operations.

LT. COL. ROBERT VAN TUYLE, who has been associated with Emery Industries, Inc., Cincinnati, Ohio, since 1934, with the exception of the war years when he served with the Chemical Warfare Service, has been appointed director of research of that organization.

HARLAN A. DEPEW, until recently manager of the rubber section of the research department of the Flintkote Co., has joined the Metallurgical Department of the American Zinc, Lead & Smelting Co., headquarters of which are at St. Louis, Mo. He is currently on a special research assignment.

H. H. BASHORE, well-known rubber technologist, who recently joined the Swan Rubber Co., Bucyrus, Ohio, as director of research, has left that organization.

WILLIAM D. SCHAEFFER, recently awarded an M.S. degree by Lehigh University in the field of physical chemistry after he returned from overseas service with the Army Air Forces, has joined the research and development staff of Godfrey L. Cabot, Inc., Boston, Mass.

DR. CARY R. WAGNER, well-known scientist in the field of petroleum chemistry, has been elected vice-president in charge of research and development of the General Aniline & Film Corp. He will make his headquarters in New York City.

DONALD CARROLL, who has been superintendent of the tire cord plant of the U. S. Rubber Co., at Scottsville, Va., since the beginning of the year, has been named manager of that plant.

L. I. BERRY, who has been serving as superintendent of construction and installation of new equipment for the Hewitt Rubber Co. for the past several years, has been appointed production engineer for the molded hose division of the Thermoid Co., Trenton, N. J.

EDWARD M. KRECH, formerly associated with the Singer Manufacturing Co., has joined the J. M. Huber Corporation as director of purchases. He will make his headquarters at the Brooklyn, N. Y., plant.

W. H. WRIGHT, long associated with the tire manufacturing industry, who recently returned to the United States after serving at the Firestone tire plant in Portugal, has joined the Cooper Tire & Rubber Co., Findlay Ohio, as chief chemist.

HERBERT J. NOBLE, vice-president and treasurer of the Taylor Instrument Companies, Rochester, N. Y., has been elected to the position of executive vice-president and assistant general manager of that company. He first joined the Taylor organization in 1907 as an accountant.

McElligott Joins Schulman

J. K. McElligott, formerly vice-president of the Loewenthal Co., of Akron and Chicago, widely known in the scrap rubber industry, has joined the firm of A. Schulman, Inc., Akron, in a sales executive capacity.

ARTHUR G. JANSSEN, formerly associated with the Flintkote Co. at East Rutherford, N. J., has been appointed to the faculty of the University of Wyoming.

DR. RAYMOND C. BENNER, recently retired from the Carborundum Co. as director of research, and who has been offering an independent consulting service in recent months, has been selected as one of 40 prominent American industrialists to advise GEN. DOUGLAS MACARTHUR on Japanese reparations policy.

E. M. CUSHING and RUSSELL WILKS, both associated with the U. S. Rubber Co. for some time, have been appointed industrial relations director and public relations director, respectively, of that company.

ERNEST R. HANSON, formerly associated with the Halowax Corporation and the Bakelite Corporation, has joined the staff of Foster D. Snell, Inc., New York City, to head up research and development in the field of plastics and rubber.

H. BARDEN ALLISON, formerly district sales manager of mechanical goods in the Cincinnati area, has been appointed sales manager of the Gilmer Division of the U. S. Rubber Co., the V-belt manufacturing and distributing unit in Philadelphia, Penna.

ROBERT H. BOYLE, until recently a tire division foreman for the Goodyear Tire & Rubber Co. at Akron, has been named division superintendent of the company's tire plant in Buitenzorg, Java.

CALIFORNIA RUBBER GROUPS ARE PARTICIPATING IN EXPOSITION

The technical conference on rubber scheduled as one of the features of the Pacific Chemical Exposition to be held at the San Francisco, Calif., Civic Auditorium, on October 21 to 25, 1947, under the auspices of the California Section of the American Chemical Society, some details of which were furnished in our last issue, has been considerably expanded. The Los Angeles Rubber Group has joined the Northern California Rubber Group in sponsorship of the rubber sessions.

The program, as now completed, calls for three separate sessions, one each on the afternoon and evening of Thursday, October 23, and one on the afternoon of Friday, October 24. In addition, a dinner will be held by the groups on Thursday evening at the Hotel Whitcomb. No registration fees of any kind are involved and everyone registering at the Exposition is invited to attend the technical sessions.

The program as finally devised is planned to explore new developments in rubber chemistry and their application to new industrial fields. L. H. Dimpfl, of the California Research Corp., will act as chairman at the rubber sessions, the first of which, on the afternoon of October 23, will be devoted to a series of talks on the various synthetic elastomers. A commentary on "Rubber Compounding" will first be given by Leonard Boller (Technical Coatings), after which GR-S will be discussed by D. C. Maddy (Harwick Standard Chemical), neoprene by Herman Jordan (DuPont), Hycar by Ray Bitter (Goodrich Chemical), Thiokol by Walter Boswell (Thiokol), and Perbunan and Butyl by E. N. Cunningham and R. M. Howlett (Enjay).

The session on Thursday evening, October 23, will feature a talk on "Molecular Structure and Mechanical Properties of Polymers," by Dr. Herman F. Mark, director of polymer research of the Polytechnic Institute of Brooklyn, as well as a panel discussion on "Compounding." The following will participate in the panel discussion: Ross Morris (Mare Island Rubber Laboratory), Leonard Boller (Technical Coatings), E. B. Reinbold (Pacific Rubber), Don Good (American Rubber Manufacturing), Russell Kettering (Oliver Tire), John Liljegren (Pioneer Rubber Mills), and George Petelin (Goodyear Rubber).

Four papers will feature the concluding session on Friday afternoon, October 24. These are: "Carbon Black and Other Compounding Agents," by William R. Snyder, of the R. T. Vanderbilt Co.; "Foam Rubber, Hard Rubber, and Other Specialties," by Ralph T. Hickcox, of the Goodyear Tire & Rubber Co.; "Mechanism of Pigment Reinforcement of Rubber," by L. H. Cohan, of the Witco Chemical Co.; and "Solubility of Hydrocarbon Resins and Their Behavior in Rubber Compounds," by Paul O. Powers, Battelle Memorial Institute.

Establish Crude Rubber Division

The establishment of a Crude Rubber Division has been announced by North American Continental Co., Inc., 2 Broadway, New York 4, N. Y. The new division will function as an importer of natural rubber as well as a shippers' agent. The division will be under the direction of P. V. L. Bouton, well-known figure in rubber trade circles, who was associated with Charles T. Wilson & Co. from 1915 to 1920 and who acted as an independent rubber broker from 1920 to just prior to World War II. Mr. Bouton, formerly a member of the Commodity Exchange, Inc., is now a member of the Board of Governors of that Exchange. He recently returned from a lengthy trip to the Far East. North American Continental has established its own packing houses in various shipping areas. The company is a subsidiary of the Continental Grain Co., which operated packing centers in Singapore before the war.

Report on German Waxes

Published in cooperation with the Office of Technical Services of the Department of Commerce, a special report on "Economic Study of German Synthetic Waxes," translated from the German by S. S. Cosman and reviewed by P. F. Dewey, has been made available. Formulas and methods of production are contained in the report, which consists of 31 pages, and which can be secured at a cost of $10.00 per copy from P. F. Dewey, 1516 Spencer Ave., Wilmette, Ill.

Handling of Geon Latex

A new service bulletin (No. 47-L-2) on the handling and storage of Geon latex has been made available by the B. F. Goodrich Chemical Co., Rose Building, Cleveland 15, Ohio. Geon latices are colloidal dispersions of vinyl chloride polymers in water. The bulletin describes the proper equipment to be used in storing the latices and checks to make while they are in storage to maintain their stability.

CHANGES AND NEW TEST METHODS PROPOSED BY A.S.T.M. COMMITTEE

Committee D-11 on Rubber and Rubber-Like Materials presented three new tentative test methods to the American Society for Testing Materials at the recent Fiftieth Annual Meeting of the Society held in Atlantic City, N. J., as follows:

A method of test for contact and migration strain of organic finishes by vulcanized rubber gives procedures for producing under standardized conditions strains caused by vulcanized rubber compounds on organic finishes. This method is of particular importance in the manufacture of refrigerators, washing machines and light-colored automobiles (D-925-47T).

A procedure for determining the plasticity and recovery of uncompounded, compounded, or reclaim stocks of unvulcanized rubber and rubber-like materials employs the Williams' parallel plate plastometer which has been used for a number of years (D-926-47T).

The third tentative method covers a standard procedure for determining the viscosity of uncompounded, compounded, or reclaim stocks of unvulcanized rubber and rubber-like materials by means of the Mooney viscometer (D-927-47T).

Changes are effected in three existing tentatives, namely, the test method for compression set of vulcanized rubber (D-395-T), incorporating the use of plied specimens; the test method or indentation of rubber by means of the durometer (D-676-T), permitting the use of the Rex durometer or any other complying instrument of the maximum reading type; and the method of heat aging of vulcanized natural or synthetic rubber by the test tube method (D-865-T), consisting essentially of provision for entrance of additional air into the test tubes by convection currents through tubes inserted in the stoppers.

A revision for immediate adoption in the standard methods of test for abrasion resistance of rubber compounds (D-394) deletes the use of the United States Rubber Co. abrader method. Extensive revisions in the standard method of test for adhesion of vulcanized rubber to metal (D-429), which include the addition of a stripping method, necessitated the reversion of this standard to tentative.

Cambridge Consolidates Production

The Cambridge Rubber Co. has announced that all manufacturing operations of the company in the United States are now consolidated in its Maryland and Pennsylvania factories. The executive, accounting and merchandising offices in charge of all the Maryland, Pennsylvania and Canadian rubber footwear factories of the company remain at Cambridge, Mass. The company has also announced a complete new program for its Vul-Cork soles, featured by a return to the pre-war rubber formula.

FINANCIAL NEWS

B. F. GOODRICH COMPANY REPORTS NET OF $11,264,245

Consolidated net income of the B. F. Goodrich Co. for the first six months of 1947 amounted to $11,264,245, after reduction of raw material inventory from cost to market, provision for estimated Federal and foreign income taxes, and reserve of $2,000,000 for contingencies, which includes reduction of raw material commitments from cost to market. This compares with $12,470,390 in the 1946 period, after provision for taxes and a reserve of $3,000,000 for contingencies. The 1947 income is equal to $7.82 per common share as compared with $8.74 in 1946.

Consolidated net sales for the 1947 period amounted to $201,283,642, an increase of 22.8% over the $163,857,141 in the previous year. The value of production from government-owned plants operated by the company is not included in the sales for either period. The consolidated balance sheet as of June 30, 1947, indicates current assets of $169,402,918 and liabilities of $51,905,037, a ratio of 3.3 to 1. Inventories on that date amounted to $101,366,176, compared with $68,072,264 at June 30, 1946.

Anaconda Wire & Cable Co.

First Half: Preliminary report indicates net profit of $4,638,251, after Federal income taxes and contingencies, which is equal to $10.99 each on 421,981 capital shares, and compares with $578,949, or $1.37 a share, for the corresponding period in the previous year. For the quarter ended March 31, 1947, net profit was $2,483,214, or $5.88 a share, as compared with $6,233, or 1c a share, in the March, 1946, quarter.

Columbian Carbon Company

First Half: Net income of $3,231,259, equal to $2.00 a share, which compares with $2,668,191, or $1.65 a share, in the first six months of 1946. Sales for the respective periods were $20,606,010 and $16,527,105. The company recently purchased for cash the 50% stock interest of the Phillips Petroleum Co. in the Columbian-Phillips Co.

American Cyanamid Company

First Half: Net profit of $4,686,301, after provision of $3,000,000 for taxes, which is equal to $1.58 each on 2,737,526 common shares, and compares with $4,261,869, or $1.44 each, in the 1946 period. Net sales increased from $85,012,396 in the 1946 period to $103,555,216 in the first six months of the current year.

Intercontinental Rubber Co.

First Half: Net loss of $12,973, which compares with net profit of $90,304 reported for the corresponding period of the previous year. The loss was attributed to the hampering of operations during the period by the lack of guayulé shrub for processing. The supply of wild shrub has rapidly diminished, due to excessive harvesting during the war emergency, only small undersized and therefore expensive shrub remaining. Lower prices for guayule rubber also contributed to the loss. As of June 30, 1947, total current assets amounted to $1,429,425, as against total current liabilities of $87,089. The report included activities of all subsidiaries.

Thermoid Company

First Half: Net profit of $506,060, after provision of $395,534 for Federal income taxes, which is equal to 72c a share on 602,464 common shares, and which compares with $205,234, or 23c a share, in the corresponding period of 1946. Sales amounted to $12,488,522, against $10,942,967 in the 1946 period. Expanded export sales were reported to have taken up the slack in the company's automobile replacement division.

Thiokol Corporation

First Half: Net profit of $40,485 as compared with a loss of $12,608 reported for the first six months of the previous year. Sales amounted to $617,979 against $540,784 in the 1946 period. The 1947 profit is after provision of $12,206 for Federal income taxes.

Additional Committees Named

Members of various subcommittees working with the Local Arrangements Committee for the meeting of the A.C.S. Rubber Division to be held at the Hotel Commodore in New York City later this month (September 17-19) were listed in our previous issue. The complete membership of two additional subcommittees have since been revealed, as follows: *Hospitality Committee:* D. E. Jones, chairman (American Hard Rubber), J. Breckley (Titanium Pigment), T. A. Bulifant (Barrett), E. N. Cunningham (Enjay), A. R. Luvis, F. S. Malm (Bell Telephone), S. M. Martin, Jr. (Thiokol), D. C. Scott, Jr. (Scott Testers), and F. E. Traflet (Pequanoc); *Meeting Rooms Committee:* George R. Lawson, chairman (Sharples Chemicals), J. Breckley (Titanium Pigment), Gus Maassen (Vanderbilt), and Bryant Ross (Sharples Chemicals).

Goodyear Improving Jackson Plant

Further extension of a general modernization program to include a $500,000 steam generating and water treating plant that will replace or supplement obsolete equipment at its Jackson, Mich., plant has been announced by the Goodyear Tire & Rubber Co. Work is already underway on the foundation of a new $100,000 building that will house two virtually new boilers capable of increasing the plant's steam capacity 70 percent. One of the major improvements being embodied in the modernization plan at Jackson is a $25,000 fly ash eliminator which works on the same principle as a cream separator in discharging ash into a collecting bin and permitting only gases to emit from the stacks. The new system will eliminate all dirt normally transmitted into the air.

Plastilock 601 Adhesive

Plastilock 601, a new synthetic adhesive for bonding brake linings to brake drums, has been introduced by the B. F. Goodrich Co., Akron. The new adhesive is said to have more than twice the shear resistance of brass rivets generally used in anchoring brake linings, and is reported to eliminate rivet scoring of brake drums. According to tests, brass rivets start to give way at 3,500 pounds and fail at 5,000 pounds. Lining attached with Plastilock 601 holds fast up to 10,000 pounds of shearing pull. Plastilock 601 is available in either tape or liquid form.

General Making Tractor Tires

The General Tire & Rubber Co., out of the tractor tire field since the outbreak of World War II, has resumed production on a complete line of self-cleaning, open center tread, rear tires, as well as center-ribbed front tires for tractors. The company revealed more than a year ago that it would bid again for agricultural business, but manufacturing was held up until extensive field tests and experiments were concluded. The flare angle of the tread of the new tractor tires is reported to throw out dirt as the tire rolls over the ground.

Forms Allied Products Section

In an effort to strengthen the position of battery and accessory sales for dealers in the field, the tire division of the U. S. Rubber Co. has formed a new department, known as the Allied Products Section, to correlate all activities involving these and allied commodities. Foster M. Stewart has been appointed as manager of the new section.

Development of a line of clear and colored surface finishes for polystyrene plastics has been announced by the Monsanto Chemical Co. The lacquers are said to overcome the tendency of solvents to produce "crazing" in polystyrene.

Hong Kong Rubber Difficulties

According to information reaching the U. S. Department of Commerce, rubber factories in Hong Kong were recently given six months' notice by the government to find more suitable premises. They were originally located in residential areas and, by government orders, were moved to their present locations, which are defined as "domestic premises." The firms are now notified to move to "nondomestic" buildings, but they state that this is not feasible because of the lack of suitable and inexpensive sites and the high cost of building. They claim that this threatens the existence of the industry, which also has been affected severely by the Chinese Government's ban on imports, causing a number of the Hong Kong factories to move to Canton. The markets of Malaya and Siam, which were practically monopolized by Hong Kong firms before the war, have also been in part closed by the establishment of rubber-shoe factories in these areas, and the trade with South Africa and the United Kingdom has also declined.

A technical bulletin on "Wilmac R in Natural Rubber Carcass Stocks" has been made available by the Wilmington Chemical Corp., Wilmington, Del. Another bulletin, "Improved Aging with Retardac 15A," has also been made available by the company. Subject material is indicated by the titles.

According to U. S. Rubber, one million fish can be unloaded from a boat in less than two hours by means of a new vacuum hose developed by the company that sucks up the fish and sends them speeding to storage bins 1500 feet away. The new unloading system is being used by the Consolidated Fisheries at Lewes, Delaware.

A revolutionary new paint, made from a water dispersion of a synthetic resin instead of customary drying oils, has been developed as the result of joint cooperation between the Shawiningan Products Corp. and Foster D. Snell, Inc. The new paint is said to dry in less than half an hour without odor, yet possesses the durability and finish of high class oil paints.

"Looking Beyond the Price Tag" is the title of a new booklet issued by the Electric Industrial Truck Association, Long Island City 1, N. Y. It includes a discussion of basic requirements of mechanized material handling systems and the importance of continuity once the flow of materials is mechanized.

One of the newest uses for sponge rubber is for lining metal chutes of fruit grading machines, according to Goodrich. Using sponge ⅛-inch thick protects fruit against bruises while it is being sorted and lessens the vibration and noise which had been caused by the fruit dropping into the chutes.

Heads Goodyear's Topeka Plant

Walter H. Rudder

Walter H. Rudder has been appointed plant manager of the Goodyear Tire & Rubber Company's Topeka, Kansas, tire factory, succeeding Leland E. Spencer who has been loaned to the War Department for a year on leave of absence to assist in the economic rehabilitation of Germany. Previous to his assignment in Topeka, Mr. Rudder was production superintendent of the company's Gadsden, Ala., plant. He went to Gadsden in January, 1946, following a wartime assignment as manager of the Goodyear Lincoln, Nebraska, factory which began production of fuel cells in 1943. Mr. Rudder had engineered military fuel cells for the company at Gadsden in 1942. Before that, he was on chemical compounding at the Gadsden factory where he started in 1929 as an analytical chemist, following graduation in 1928 from Alabama Polytechnic Institute.

Vanfre Liquid Coating

Vanfre, a liquid developed for coating rubber prior to curing in a lead jacket, has been introduced by the R. T. Vanderbilt Co., New York City. Designed to eliminate mica and other dusting powders, the new material may be applied as a dip, spray or by brushing.

The buildings, machinery and other plant equipment of William Sellers & Co., Philadelphia, Penna., tool manufacturer, were recently purchased by Harry H. Robinson in a transaction involving approximately $1,000,000.

A soft rubber mat, made of one-inch thick cellular rubber, has been introduced by U. S. Rubber to protect boxers from head injuries. When placed under the regular ring canvas, the mat is said to have remarkable ability to absorb shock.

Assumes Guayule Experimental Work

The experimental work on guayule which was maintained by the U. S. Navy Department last year has been assumed by the U. S. Department of Agriculture. The Department's Bureau of Plant Industry has an appropriation of $170,000 for this work and the Bureau of Agricultural and Industrial Chemistry one of $179,000. Dr. Marion Walker, principal pathologist of the Department, is project leader of the guayule research organization, which has a staff of some 20 persons, largely taken over from the Navy. The area at present planted with guayule is 330 acres, most of which will soon be ploughed up. The Bureau of Plant Industry will then replant numerous small experimental plots. The pilot plant for extraction of rubber from guayule will be the subject of further experimental work on the part of the Bureau of Agricultural and Industrial Chemistry.

Ordinary bicycles now can be converted into speedy gasoline-driven motorbikes within a few hours as the result of a new principle in V-belt construction. The new belt, devised by Goodyear, utilizes endless steel cables for carcass reinforcement. Each cable comprises 21 tightly-woven strands of high tensile steel wire.

A four-page bulletin presenting facts about rubber-lined steel in industry and other protective surface coatings is available from Metalweld, Inc., Philadelphia 29, Penna. Featured are tables giving resistance characteristics of rubber linings to inorganic acids, inorganic salts, alkalies, and organic materials.

Return of garden hose to its line of mechanical goods has been announced by Goodyear. Production of three brands is now under way and the hose will be back on the market early next year. The line includes the Wingfoot, Pathfinder and Glide brands.

A new conveyor belt said to be 250 to 400 per cent stronger than previous rubber-fabric belts has been developed by the Dominion Rubber Co., Ltd., Montreal, Canada, for conveying coal, pulpwood, iron ore and other bulky materials over long distances. Key to increased strength is a new textile construction of nylon and Ustex yarn.

A new brochure describing the company's steel rule die method of die cutting has been made available by the Accurate Steel Rule Die Co., 22 West 21st St., New York 10, N. Y. The method is adaptable to cutting flat, soft or semi-soft sheets to any flat shape or size, including such materials as rubber, plastics, cloth and felt.

Approval of the cross-wind landing gear for tricycle gear aircraft, featured by Firestone, has been granted by CAA.

OBITUARIES

R. Emmett Carroll

R. Emmett Carroll, president of R. E. Carroll, Inc., well-known sales agents in the Trenton area, representing several leading suppliers of rubber chemicals and compounding ingredients, died suddenly at his home in Trenton, N. J., on September 2 as the result of a heart attack. He was 52 years old.

Mr. Carroll was one of Trenton's most popular business men and public figures. From 1935 to 1940 he served on the Trenton Board of Education. Since 1942 he was a member of the City Commission. Other public posts included the general chairmanship of a Trenton Community Chest Drive and membership on the board of trustees of the former School of Industrial Arts, now known as the Trenton Junior College. He was also active politically, serving as regional campaign manager for Albert W. Hawkes when he ran for the Republican senatorial nomination in 1942.

Always interested in industrial activity, Mr. Carroll held memberships in the National Association of Manufacturers, the U. S. Chamber of Commerce, the National Paint, Varnish & Lacquer Association, and the Trenton Chamber of Commerce. Funeral services were held on September 6. Surviving are a widow, a son, two sisters, and three brothers, Dr. C. Walter, Elvin and James.

Earle W. McMullen

Earle W. McMullen, director of research for the Eagle-Picher Co. and prominent in engineering chemistry circles, died on August 26 at Mt. Carmel Hospital in Pittsburg, Kansas. He was 60 years of age. Born in Canada on July 10, 1887, Mr. McMullen was a graduate of the Armour Institute of Technology, now the Illinois Institute of Technology. He graduated with the class of 1908, and then remained with the Institute as a teacher of chemical engineering. His first professional position was with the Simmons Co., of Kenosha, Wisconsin, where he was employed as director of research for 15 years. Later he served with the Celotex Corporation and the Ault and Wiborg Co. He joined Eagle-Picher in 1935 as director of research and served in that capacity until his death. A member of the American Chemical Society since 1908 and of the American Society for Testing Materials since 1916, he was also a member of the American Institute of Chemical Engineering and the American Institute of Mining and Metallurgical Engineers. A widow, son and daughter survive.

Joseph L. Usow

Joseph L. Usow, president and owner of the Marathon Rubber Products Co., Wausau, Wisconsin, died in a local hospital after an illness of three weeks on July 20. He was 52 years of age. Born in Russia in 1894, Mr. Usow came to the United States in 1912. After living in Port Washington, Wisconsin, for several years, Mr. Usow came to Wausau in 1934 and purchased the Marathon Rubber Products Co. in April of that year. The company specialized in raincoats and produced such products for the Army and Navy during the late war. In July, 1942, Mr. Usow purchased the Bonnie Doon dairy farm, and in February, 1946, the J. M. Kuebler Co., a wood products manufacturing firm. Funeral services were held in Milwaukee with interment in a Milwaukee cemetery. Survivors include two sisters and two brothers.

I. Henry Hirsch

I. Henry Hirsch, president of Adolph Hirsch & Co., of New York City, importers, dealers and commission merchants in raw materials, including rubber before the war, died in Rio de Janeiro, Brazil, on August 21, while on a vacation trip. He was 71 years of age. Born in New Rochelle, N. Y., Mr. Hirsch was graduated from New York City College in 1895, and from that year until 1910 he lived largely in Brazil where he represented the interests of various American importers of Brazilian raw products. For the past 35 years he was associated with Adolph Hirsch & Co. in New York. Before the merger of the New York Rubber Exchange into the Commodity Exchange, Inc., he was a member of the board of governors. He had also served as president of the New York Cocoa Exchange for several years. The body was returned to the United States for interment.

William H. McIntyre

William H. McIntyre, sales executive of the American Mineral Spirits Co., working out of the New York office, died at his home in Garden City, L. I., N. Y., on September 5, as the result of a heart ailment. He was 49 years of age. A graduate of Pratt Institute, Mr. McIntyre joined American Mineral Spirits some 18 years ago. An aviator in the first World War, he was commander of the Gilbert Doyle American Legion Post in Brooklyn, N. Y. A widow survives.

Sir Harold Kenward

Sir Harold Kenward, Deputy Chairman of the Irish Dunlop Rubber Co. and a director of the Dunlop Rubber Co., Ltd., of England, died at sea aboard the *Queen Elizabeth* on August 29. He was 53 years of age that day. Sir Harold was on his way to Buffalo and Toronto to study problems of peacetime distribution. He was buried at sea. Born in Sussex, England, Sir Harold was associated with the Dunlop organization since 1911, except for a four-year interval during World War I when he served with both the British Army and the U. S. Air Force. He was said to have been the youngest quartermaster sergeant in the British Forces. Sir Harold was knighted in the New Year Honours for his services to the British Ministry of Supply in connection with the tire industry. He was president of the Tire Manufacturers Conference, the organization to which all British tire manufacturers belong. The Conference was chiefly responsible for avoiding a tire famine in England during the late war years during which its output reached approximately 80,000,000 tires.

Benson Process Reduces Prices

Major reductions in the price of its general purpose antioxidant, PDA-10, have been announced by the Benson Process Engineering Co., Eden, N. Y. The reduction follows closely upon a previous 3-cent per pound reduction announced by the company last July. Present prices for the material range from 40 to 42 cents per pound with contract prices for equal monthly or quarterly shipments ranging from 37 to 39 cents a pound. PDA-10 is recommended by the manufacturer as a replacement for old line antioxidants, such as phenyl beta naphthylamine.

Chrysler Adopts Super-Cushions

All Chrysler 8-cylinder cars, comprising the New Yorker, Saratoga, Town and Country, and Crown Imperial models, henceforward will be equipped with the new Super-Cushion tires recently introduced by the Goodyear Tire & Rubber Co. This makes the Chrysler Corporation the first automobile manufacturer to make the new type of tire available to the public as original equipment. The Super-Cushion is a larger, softer tire which is reported to give greatly increased riding qualities.

Purchases Additional Shares

The Columbian Carbon Co., New York City, recently purchased 1,700 shares of the capital stock of the Columbian-Phillips Co. The stock represented the 50 percent interest of the Phillips Petroleum Co. in the concern. Columbian was heretofore jointly owned.

TECHNICAL REPORTS AVAILABLE FROM THE DEPARTMENT OF COMMERCE

Data on additional reports on industrial and technical developments which occurred throughout the world during the wartime period are listed below. This information is taken from the "Bibliography of Scientific and Industrial Reports," issued by the U. S. Department of Commerce, and copies of the reports listed may be secured, at the prices indicated, from the Office of Technical Services, Department of Commerce, Washington 25, D. C. Remittances made payable to the Treasurer of the United States must accompany order. Titles of the more recent reports follow:

Status of Methods of Application and Use in the Synthetic Rubber Field. By E. Konrad. Translation of addresses given by the technical director of the I. G. Farbenindustrie rubber laboratories at Leverkusen. — Report No. PB 13355. 54 pp. Photostat, $4; Microfilm, $1.

Method for the Preparation of Butadiene. Patent application by I. G. Farbenindustrie for a method of preparation of butadiene from 1, 3 butylene glycol. — Report No. PB 19337. 4 pp. Photostat, $1; Microfilm, 50c.

Method for the Production of Butadiene. In German. Describes catalytic separation of water from 1, 3 butylene glycol by I. G. Farbendustrie. — Report No. PB 19338. 2 pp. Photostat, $1; Microfilm, 50c.

Butadiene from Hydroaromatics. By Irvin H. Jones. Information obtained by the interrogation of Dr. George Niemann of I. G. Farbenindustrie. — Report No. PB 22440. 3 pp. Photostat, $1; Microfilm, 50c.

Modern Insulating Processes. In German. Pamphlet illustrates the various uses to which the spray insulating process patented under German Patent No. 584,037 may be put. — Report No. PB 39041. 17 pp. Photostat, $2; Microfilm, $1.

Japanese Button Type Rubber Protective Garment. By James F. Danser. Describes jacket used by Japanese for decontamination work. — Report No. PB 28481. 4 pp. Photostat, $1, Microfilm, $1.

Japanese Heavy Rubber Suit. By James F. Danser. Report on Japanese suit consisting of a coverall with belt and a pair of gloves. — Report No. PB 28486. 5 pp. Photostat, $1; Microfilm, $1.

Type 92 Rubber Hood and Jacket Decontamination Garment. By James F. Danser. Articles illustrated by photographs. — Report No. PB 28479. 9 pp. Photostat, $1; Microfilm, $1.

Utilization of Scrap Material in Our Rubber Room. By L. B. Watts and F. E. Woodward. Indicates difference in physical characteristics between new stock and that compounded with 50% scrap. — Report No. PB 30806. 4 pp. Photostat, $1; Microfilm, $1.

Plasticizer RA, the Softener for Buna Mixtures and Reclaimed Buna. In German. Contains data on the reclaiming of Buna scrap. — Report No. PB 19332. 5 pp. Photostat, $1; Microfilm, 50c.

Preliminary Leaflet on the Use of Koresin. In German. Enlargement print of part of Microfilm 185-2. — Report No. PB 19333. 11 pp. Photostat, $1; Microfilm, 50c.

Plasticizer for Synthetic Rubber. In German. Enlargement print of part of Microfilm 185-1. Patent application by I. G. Farbenindustrie for the use of esters of butyrie acid ethers as plasticizers for synthetic rubber. — Report No. PB 17617. 3 pp. Photostat, $1; Microfilm, 50c.

Method for Production of Vulcanizable Mixtures from Organic Substances which Form Films. Similar to PB 16344. — Report No. PB 16355. 3 pp. Photostat, $1; Microfilm, 50c.

Vulcanization of Isoprene. In German. Handwritten laboratory notebook recording composition of the mixtures, emulsion polymerization, duration of tests, yields, and physical test data. Enlargement print of part of Microfilm 180-3. — Report No. PB 16412. 147 pp. Photostat, $10; Microfilm, $1.50.

Report on Huls Chemical Works—I. G. Farben, Huls, Germany—near Marl. By J. W. Livingston, Similar to PB 13357, plus additional information. — Report No. PB 23022. 32 pp. Photostat, $3; Microfilm, 50c.

Synthetic Rubber Plant, Huls, Germany; Chemische Werke, Huls. Report by the U. S. Strategic Bombing Survey on the plant and its importance to the German war program, air attacks and the effects of bombing, production losses, vulnerability and recuperability of the plant. A brief description of processes and equipment in rubber synthesis, preparation of butadiene, styrene, Buna, and ethylene glycol is included. — Report No. PB 23385. 91 pp. Photostat, $7; Microfilm, $1.

Vulcanizing Equipments TE-54-A, TE-55-A, TE-54-B, and TE-55-B. Describes installation and operation, functioning of parts and maintenance of equipment used by the U. S. Signal Corps for splicing and patching cables and also for splicing two cables to one cable. — Report No. PB 22219. 35 pp. Photostat, $3; Microfilm, 50c.

Test Apparatus for Rubber or Elastic Materials. In German. Application by I. F. Farbenindustrie for a registered design on equipment for testing rubber or elastic materials for torsional and bending resistance and fatigue. — Report No. PB 18294. 10 pp. Photostat, $1; Microfilm, 50c.

Advances in Acetylene Chemistry. By Reppe. Translation of an address by the director of the Ludwigshafen plant of I. G. Farbenindustrie in July, 1940, on new techniques in the handling of acetylene in the preparation of vinyl compounds — Report No. PB 13366. 30 pp. Photostat, $1; Microfilm, 50c.

Igelit for the Soft Rubber Industry. Advertising pamphlet of I. G. Farbenindustrie which describes the physical and chemical characteristics and uses of Igelit, a trade name for a polyvinyl chloride, useful as a rubber substitute. Enlargement print of part of Microfilm 180-2. — Report No. PB 17339. 8 pp. Photostat, $1; Microfilm, 50c.

Continental Gummiwerke A. G. Hanover. By S. J. Steadman and others. Report deals mainly with rubber items of chemical warfare interest which were produced at the Limmer factory on the outskirts of Hanover in Germany. — Report No. PB 7908. 15 pp. Photostat, $1; Microfilm, 50c.

I. G. Central Rubber Organization at Leverkusen. By W. J. S. Naunton and others. Latest technical advances in rubber research at the Central Laboratories are described. — Report No. PB 32161. 486 pp. Photostat, $33; Microfilm, $10.

High Pressure Polymerization of Ethylene. By Hopff and Goebel. Translation of a German paper presented at the 26th Kuko (Plastics Committee) meeting in Ludwigshafen on February 15, 1943. The paper has already been reported in PB 11423 and PB 6371. — Report No. PB 19486. 23 pp. Photostat, $2; Microfilm, 50c.

Emulson Polymerization of Ethylene. Hopff and Kern. Translation of a German paper presented at the 26th Kuko (Plastics Committee) meeting in Ludwigshafen on February 18, 1943. The paper has already been reported in PB 11424. — Report No. PB 19485. 47 pp. Photostat, $4; Microfilm, 50c.

Accelerators and Age-Resistors. By A. E. Boss. Translation excerpt from a sales bulletin entitled "Handbook for the Rubber Industry,' which gives a short description of products produced by I. G. Farbenindustrie for the rubber industry. — Report No. PB 13338. 19 pp. Photostat, $2; Microfilm, 50c.

Manufacturing Process for Desmodur R. By N. A. Copeland and M. A Youker. — Report No. PB 19858. 8 pp. Photostat, $1; Microfilm, 50c.

Continental Gummi Werke — "Excelsior" Factory, Limmer, Hanover. By Glen Gay. Covers the processes for heat softening Buna, and the manufacture and testing of gas masks, coated fabrics, soles and heels in the Excelsior factory, one of three Continental plants in Hanover, Germany. — Report No. PB 20462. 13 pp. Photostat, $1; Microfilm, 50c.

LOS ANGELES NEWS

Southern California's fabulous $73,000,000 synthetic rubber industry—admittedly a major factor in winning the war—has deflated with the bang of a punctured balloon. Already closed in the drastic Federal curtailment program are the copolymer plant which was operated by the U. S. Rubber Co. and the butadiene plant of the Southern California Gas Co. The only remaining copolymer unit is that operated by the Goodyear Synthetic Rubber Corp., which is supplied with butadiene by Standard Oil and styrene by Dow Chemical. Minimum production will be maintained at this plant.

In Los Angeles the "synthetic rubber miracle," part of a nation-wide program developed in one hectic year under the direction of William M. Jeffers, was accomplished so swiftly that the plants went into operation in June, 1943. The Aliso St. butadiene plant of the Gas Company supplied more than 85,000 tons of raw butadiene during four years, which in turn was processed at Shell Chemical and combined with styrene from Dow Chemical to make the rubber. The rubber produced was enough for 17,000,000 tires.

L. R. Keltner, superintendent of the tire division of the B. F. Goodrich Co. at Akron, has been named manager of the company's local plant. He succeeds P. W. Perdriau, who assumes Mr. Keltner's former post in Akron. Mr. Keltner has been with Goodrich since 1926, after being graduated from the University of Missouri with a degree in chemistry. After serving in the general laboratories for two years, he entered the tire division as a compounder. Superintendent of the Akron tire division since 1945, he had previously been assistant technical superintendent of the division and handled many special technical assignments during the war.

The Los Angeles Rubber Group will resume its monthly meetings on October 7th. Jack C. Ballagh (Patterson-Ballagh) is slated to speak on the present economic condition of England and Europe. Mr. Ballagh's recent trip abroad will enable him to give the members a first-hand report of what he saw. Another highlight of the meeting will be moving pictures of the Group's summer outing on Catalina Island.

A new patent finish plastic has replaced leather in an experimental shoe designed by Aronov of California, and recently exhibited for the first time. None of the usual faults found in patent leather have shown up in the unique new plastic material, according to the United States Rubber Company scientists who developed it. They say it will not scuff, or crack, and is resistant to abrasion. Their tests show that it remains permanently flexible and permanently retains its high finish. In addition, they claim it is washable, and not affected by salt water, alcohol, gasoline, grease or acids.

A flameproof version of the material will minimize fire hazards when used as furniture or boat upholstery, and in decorative paneling for restaurants, night clubs, and hotels, it was said.

The Goodyear Tire & Rubber Co. has announced a number of promotions among their West Coast executive personnel. R. W. Fitzgerald, formerly manager of the eleven Western States, has been transferred to Chicago as manager of the North Central Division. C. W. Thorpe has been appointed to replace Mr. Fitzgerald, and will make his headquarters in the Los Angeles Goodyear factory. S. J. Plunkett, formerly district manager in the East, has been appointed district manager in Los Angeles. C. A. Wheeler has been transferred from the Goodyear Service Stores in San Francisco to the position of assistant manager of the Los Angeles District.

Introduce New Aromatic Line

A group of new aromatics, called Res-O-Dors, especially designed for polyvinyl resin coatings, has been introduced by Givaudan-Delawanna, Inc., 330 West 42nd St., New York 18, N. Y. According to the manufacturer, the new aromatics have been tested in coated fabrics and in finished consumer products and were found to have no deleterious effect on the stability of the plastic material. Usable in small concentrations, the Res-O-Dors should be introduced when the plasticizer is mixed with the resin. They will not affect the color of the plastics, except in one or two cases where slight darkening may occur. Ten different types of Res-O-Dors are already commercially available.

Acid-Resistant Neoprene Paint

Development of a new type of acid-resistant neoprene paint, which eliminates the necessity of specially treating the surfaces to be painted, has been announced by the Union Bay State Chemical Co., Cambridge, Mass. The new paint, designed for the protection of surfaces which are subject to exposure to fats, oils and greases or corrosive chemical liquids, solids or fumes, is said to adhere well to wood, metal and other smooth surfaces. It has no odor, resists abrasive action, and dries completely in a few hours, requiring no oxidation period. If properly thinned with toluol or other thinners, the new paint may be sprayed.

CANADIAN NEWS

Following more than a year of intensive preparation, the Polymer booth at the Canadian National Exhibition was opened, and thousands of people from every corner of Canada, from the United States, and from across the sea got acquainted with this giant chemical and man-made rubber industry.

Located in the general exhibits building, the Polymer exhibit covered a floor area of nearly 2,000 square feet and proved itself one of the most dramatic and compelling presentations of the year. In charge for the duration of the exhibition was A. H. Newman, public relations manager.

On one hand, a Sonovision machine showed the new Polymer movie, never before shown anywhere. Showings of the movie alternated with demonstrations of the coagulation of GR-S carried out by Polymer laboratory technicians. In another corner was a novel apparatus known as a "butyl bubbler" which gave scientific proof of the superior air-retaining properties of butyl over natural rubber.

There was, in addition, a revolving "book," with pages turning automatically to tell the story of Polymer. A large number of samples of articles made from Polymer chemicals and man-made rubber completed the exhibit.

Goodyear Tire & Rubber Co. of Canada, Limited, has declared an extra dividend of $3 per share on the common stock, in addition to the regular quarterly payment of $1, payable October 1, 1947, to shareholders of record September 10th.

This indicates that a total of at least $7 per share will be paid for the current year, a total only exceeded by one year in the history of the company, 1938, when a total of $7.50 per share was paid.

The higher rate suggests that earnings for the current year will show substantial improvement over 1946 when $5.40 per share on the common stock was earned and just the regular $4 in dividends was paid. The last time an extra was paid was in December, 1945, when the amount was $1.75.

Know How + Perbunan = a top-notch pipe wiper!

THE QUESTION WAS . . . to find out how rubber drill pipe wipers could be made to stand up better under the beating they have to take from constant friction, abrasion and contact with crude oil, gas and other rubber-destroying hydrocarbons in oil field operations.

THE ANSWER WAS . . . A PERBUNAN compound plus the proper design. This combination was developed by research engineers of HARBOR RUBBER & PLASTICS, INC., Long Beach, California, working with the engineers from the BAROID SALES DIVISION OF NATIONAL LEAD COMPANY in designing a replaceable insert pipe wiper. The Perbunan compound provided a flexible, replaceable insert *with exceptional resistance to friction, abrasion, oil, and other hydrocarbons normally destructive to rubber!*

ALSO REMEMBER THIS: Perbunan now contains a new stabilizer that permits its use in a wide variety of colored articles where delicate colors are desired . . . and where discoloration of the rubber part or materials in contact with it would be objectionable.

If You Have a Rubber Question that needs an answer . . . please write to our office nearest you.

PERBUNAN
REG. U. S. PAT. OFF.

THE RUBBER THAT RESISTS OIL, COLD, HEAT AND TIME

ENJAY COMPANY, INC., 26 Broadway, New York 4, N. Y.; First Central Tower, 106 South Main Street, Akron 8, Ohio; 221 North LaSalle St., Chicago 1, Illinois; 378 Stuart Street, Boston 17, Massachusetts. West Coast Representatives: H. M. Royal Inc., 4814 Loma Vista Avenue, Los Angeles 11, California. Warehouse stocks in Elizabeth, New Jersey; Los Angeles, California; Chicago, Illinois; Akron, Ohio; and Baton Rouge, Louisiana.

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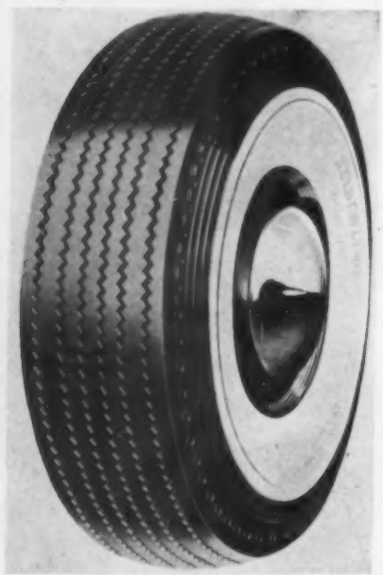
NEW RUBBER GOODS

Seiberling Heat-Resisting Tire

A new heat-resisting tire that is claimed to be "the most nearly failure-proof tire made since the war," has been introduced by the Seiberling Rubber Co.,



Akron 9, Ohio. The tire was designed not primarily for extra mileage but for safety, and it is said to represent a complete departure from the recent trend toward extra thread thickness in premium automobile tires. Principal characteristic claimed for the new tire is resistance to heat, accomplished by the elimination of excess weight, by shaping its contours to approximate its position when being driven, thus minimizing flexing heat; and by patented "heat vents" in the shoulder which ventilate the tread area and dissipate excess heat. Rayon cord fabric is utilized in the new tire.

Life-Like Lures of Neoprene

Life-like lures made of neoprene are now being featured by the Mimicry Company of Detroit, Mich, according to an announcement by E. I. du Pont de Nemours & Co., Inc. Available in the form of crickets, grasshoppers and stone flies, all of the new lures have flexible, hollow bodies, which makes them easier to handle and does not interfere when the fish strikes. The crickets and grasshoppers, like the stone flies, are life-like in appearance. The flexible legs and tails of the stone flies, however, give them a particular realistic appearance. Since they are made of neoprene, the new lures resist sunlight and aging.

Springboard Sports Shoes

A new type of shoe for sports or casual wear, featuring "Foamtread" platforms, has been introduced by the Wellco Shoe Corporation, Waynesville, North Carolina. A special type of sponge rubber compound is utilized in the manufacture of these platforms, the "blow" being adjusted to a 1 to 3 ratio. Although

the special sole lets air out, providing maximum walking comfort, it is completely waterproof. No direct contact between foot and sole is made, since layers of felt and fabric are placed above the sole. The new Springboard shoe weighs only 9 ounces and is available in a variety of colors.

Fruit and Egg Baskets

Scalding water, soap, grease and other kitchen hazards that are harmful to ordinary rubber housewares are reported to hold no terror for the new egg and fruit baskets developed by the Wooster Rubber Co., Wooster, Ohio. The coating of the wire frame remains undam-

aged in boiling water and other tests. They are easily cleaned, reduce kitchen clatter, will not scratch or mar work or storage surfaces, protect eggs and fruit, and provide full air circulation. The new baskets are offered in three popular sizes to fit any refrigerator.

Ipco One-Piece Neoprene Suit

Industrial Products Co., 2820 North Fourth St., Philadelphia 33, Penn., has introduced a one-piece neoprene suit for protection against splashes and sprays of

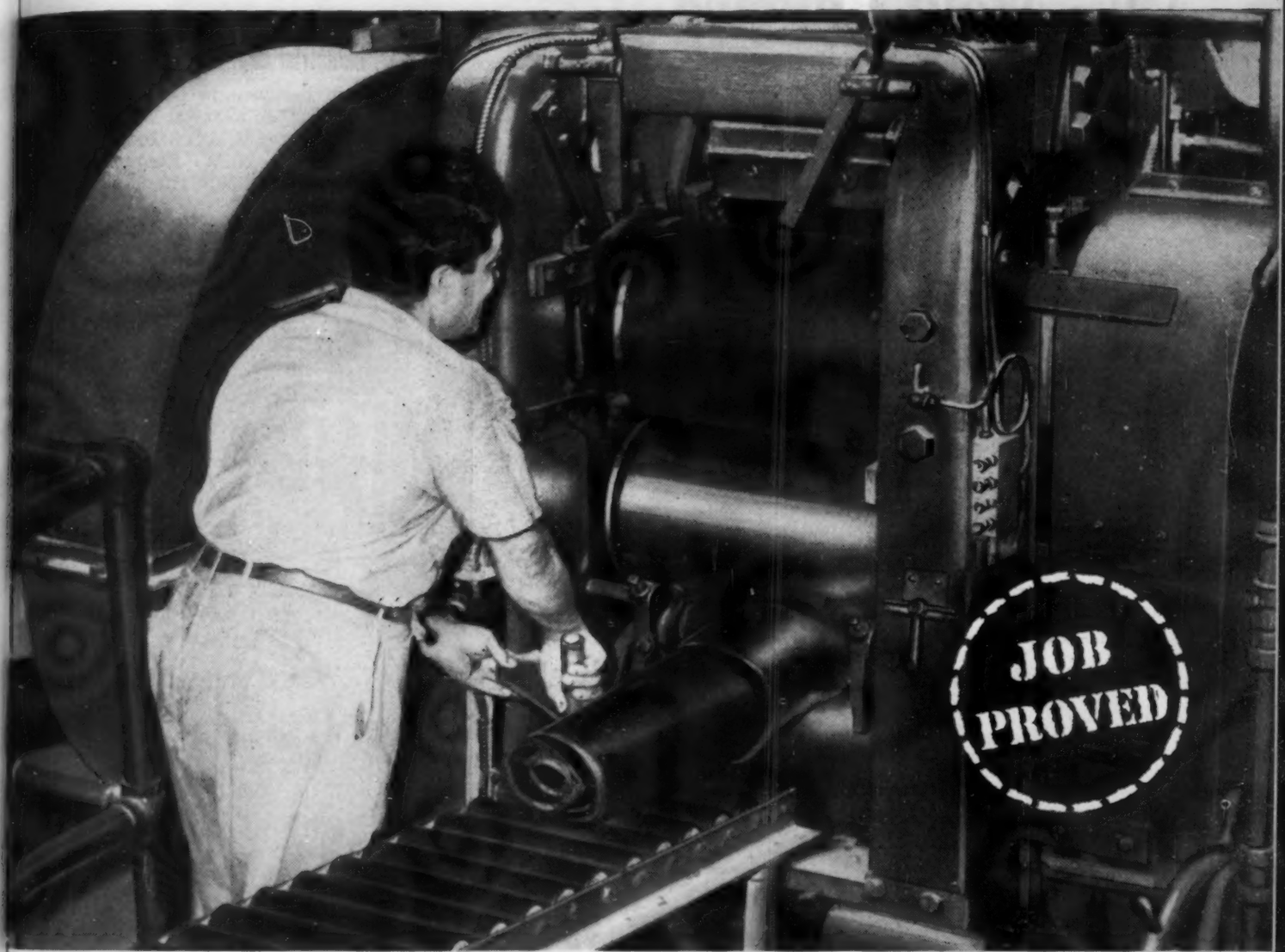
heavy acids, caustics, and oils. The suit, called the Ipco One-Piece Neoprene Suit, features a stand-up corduroy-tipped collar; a full length heavy duty zipper; sleeves fitted with gum neoprene cuffs on the inside, which fit closely to the wrist; and extra reinforcement on the bottom inside trouser legs to provide additional wear and acid resistance. The suits are available in three sizes, small, medium, and large.

New Inflatable Vinyl Toys

A new line of inflatable vinyl plastic toys, sold under the name of "Plastoys," is new being produced by Plastite, Inc., 2618 Jerome Ave., New York, N. Y. Items currently featured include Baby Bear, Freddie the Frog, and Ellie-Fant.

The toys are attractively designed in striking colors with non-toxic and fast color paints. They are electronically welded for greater material strength and water tightness, and are guaranteed not to peel or crack.

Saving $2,000 a Year



SUNDEX RUBBER PROCESSING AID...

Gives Greater Strength and Wear-Resistance to GR-S Stocks for Heavy Footwear

A manufacturer of heavy rubber footwear recently tested samples of GR-S rubber made with Sundex 53, and samples made with three other products, including his regular processing aid. In every case the rubber that had been plasticized and softened with the Sun product had better tensile strength and gave better results in elongation and abrasion tests.

A saving of $2,000 a year was effected in this plant as a result of changing to Sundex 53 — a higher quality product that costs less.

Sundex 53 is clean, uniform and easy to handle. It can be used in making various colored rubbers (other than white) without causing discoloration.

For practically every type of rubber there is a Sun processing aid that will speed up manufacture and improve quality. They do not cause surface bloom even in exacting products like chemically-blown sponge rubber, white sidewall tires and pastel-colored articles. For full information about Sun's "Job Proved" rubber processing aids, write Department RA 9.

SUN OIL COMPANY • ***Philadelphia 3, Pa.***
In Canada: Sun Oil Company, Ltd.—Toronto and Montreal

SUN
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INDUSTRIAL PRODUCTS

Even tough unloaders come out easily with

DC Mold Release Emulsion *No. 35*

The Dow Corning Silicone Release Agent

Many of the major rubber companies are changing to DC Mold Release Emulsion No. 35.

★ **It's Semi-inorganic and Therefore Heat Stable**

Silicones, which have the same type of inorganic framework found in glass, do not decompose to form carbon deposits. They withstand temperatures of 500° F. for a long time. Hundreds of hours at vulcanizing temperatures will not break them down.

★ **It Keeps Clean Molds Clean**

DC Mold Release Emulsion No. 35 forms a silicone film which keeps synthetic rubber or dirt accidentally introduced into the mold from sticking to mold surfaces.

★ **It Improves Surface Quality and Reduces Scrap**

Clean molds and easy release make sharp clean moldings. Only a very thin silicone film is necessary. Therefore non-knits and fold-overs are practically eliminated.

★ **It's Easy to Apply**

Concentrations ranging from 50 to 150 parts of water to 1 part of the Emulsion are applied by spraying with conventional equipment. Even inexperienced workers get good results because the amount to be applied is not critical.

For further information request leaflet V-62 from

DOW CORNING CORPORATION, MIDLAND, MICHIGAN

Chicago: 228 N. La Salle Street • Cleveland: Terminal Tower
Los Angeles: 634 S. Spring Street • New York: Empire State Building
Canada: Fiberglas Canada, Ltd., Toronto • England: Albright & Wilson, Ltd., London

Dow Corning
FIRST IN SILICONES

NEW EQUIPMENT

R. & W. Industrial Capper

A new vulcanizing unit, designed to perform the dual job of either bonding rubber to metal wheels or molding small rubber goods, is the R. & W. Industrial Capper manufactured by the R. & W. Engineering Corp., Hickory, N. C. The unit holds from one to

fifteen molds, depending on depth, and utilizes a combination of open steam and dry heat for curing. It is only 7 feet, 11 inches high and only 31 inches wide, and requires approximately 2½ h.p. for operation. The company also furnishes wheel molds in all sizes through 12 inches in diameter, and spacer rings make it easy to adapt the standard size molds to fit many widths of wheels at substantial savings in mold cost. Offering a complete service, the company will also supply special molds for all purposes, as well as special rubber compounds and bonding agents.

Pennsylvania Crusher Co., Liberty Trust Bldg., Philadelphia 7, Penna., has developed a new **Bradmill type unit** for reducing phenolic plastics and other chemical solids and to produce particles roughly cubical in shape with 100 percent passing the desired screen size. The two main elements are a rotating screen and a centrally located rotor carrying impact paddles.

Accelerators
Plasticizers
Antioxidants

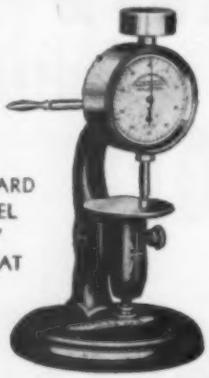
A Complete Line of Approved Compounding Materials

The C. P. Hall Co.
CHEMICAL MANUFACTURERS

AKRON, OHIO • LOS ANGELES, CALIF. • CHICAGO, ILL. • SAN FRANCISCO, CALIF.

RANDALL & STICKNEY

THICKNESS GAUGES FOR RUBBER



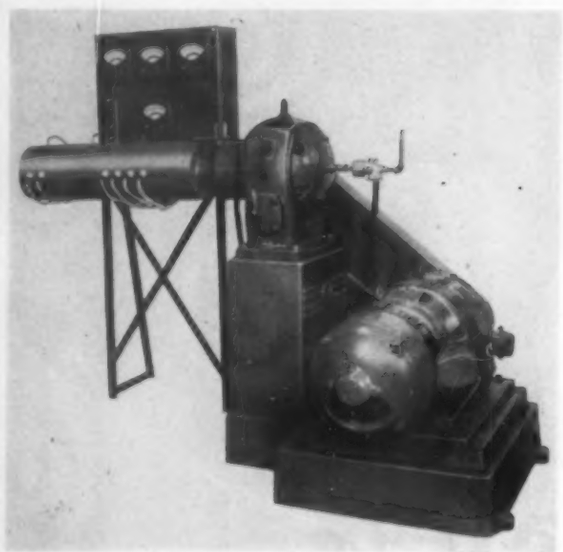
STANDARD MODEL 1¾" THROAT

THROAT DEPTHS
1¾" to 26"
FOOT TENSIONS
supplied by Internal Spring or Direct Weights
FOOT DIAMETERS
⅛" to 1¼"
ROLLS
Table and Roll or two Rolls
RANGE
½" or 1", also 1 CM Metric

26" DEEP THROAT MODEL

SEND FOR CIRCULARS to Dept. A.

FRANK E. RANDALL CO.
248 Ash St., Waltham 54, Mass., U.S.A.



THE COMPLETE, ENGINEERED
EXTRUDING MACHINE

Tested and approved for years by only a chosen few, as a custom-built machine, the G & V Extruding Machine is now available to all. No. 1 (2¼" bore) Extruder for immediate delivery.

Write for further information on the extruding machine for rubber, plastics and wire coating that is not an "adaption out of desperation", but an entire equipment designed "from stem-to-stern" for your specific production requirements.

Completely packaged units or bare machine offered for your requirement.

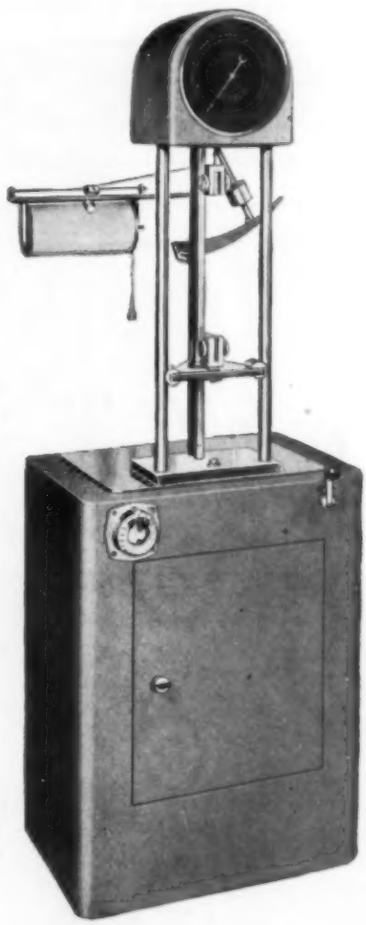
G & V MACHINE CO., INC.

30-32 DALE AVENUE **PATERSON, N. J.**

Licensed by Western Electric Co. as a manufacturer of continuous cure wire insulating extruders. Manufacturer of special head fixtures and stock screws. Extruders with oil, electric or steam heat. Accessories for all types of extruding. A complete service.

Improved Dillon Universal Tester

An improved model of its Dillon Multi-Low-Range Universal Tester has been introduced by W. C. Dillon & Co., Inc., 5410 West Harrison St., Chicago 44, Ill. Design of the new instrument, of the pendulum type, is said to have reached an amazing degree of perfection. Operation of the new model is easy to understand: A known weight is placed on the pendulum arm between two color coded marks. The arm itself is screwed to a mechanism shaft, and to the end of this shaft a precision gear sector is mounted. The upper grip is also secured to the mechanism shaft, and, as load is applied, the pendulum is gradually displaced. Turning with the shaft, the gear train greatly magnifies even the slightest load increase so that for a full scale 360° reading the upper grip travels downward ony .196 thousandths of an inch. In addition, the pendulum is displaced a maximum of only 35° of arc, making possible almost absolute linearity.

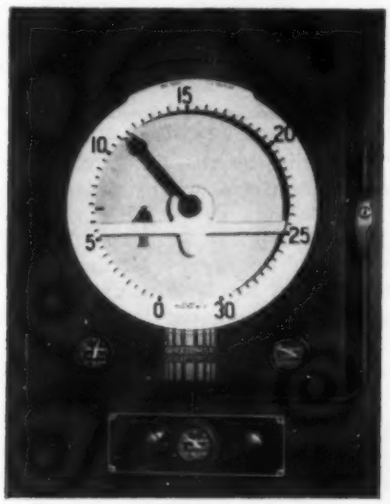


The new Dillon model features a number of other improvements. Color coding the pendulum arm makes it easy to place weights in the proper position. The dial arrangement has four scales instead of the usual one or two, each scale being differently graduated, and an accuracy of ½ of 1% of the indicated reading being guaranteed for all scales. Unusual rigidity is assured for the tester by the use of three steel pressure columns instead of the usual two. The lower platen

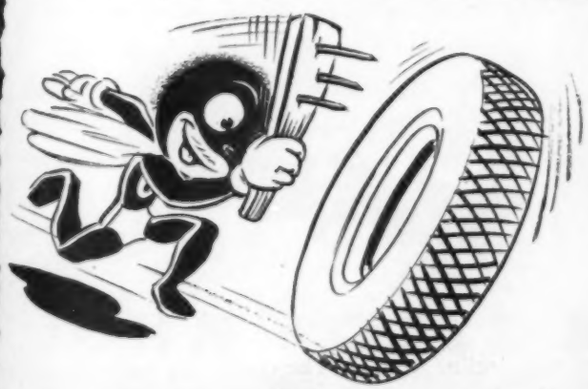
does not revolve but is held stationary between the two outer pressure columns by means of "rider" sheaves. Limiting switches, which prevent accidental overrun at top or bottom, are provided as standard equipment. The speed control, located at the front of the unit, is graduated in inches travel per minute and in fractions of inches.

New Type of Pneumatic Control

Featuring rugged, machine-like construction and heavy-duty parts throughout, a new type of pneumatic control has been introduced by the Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Penna. The new control is reported to be faster-acting, more flexi-



ble and more compact than any of the company's previous models, and is said to have already demonstrated a unique ability to handle process upsets, returning temperature, or other condition, to the control point in remarkably short time. The L & N Pneumatic Control can be supplied to control temperature, pH, gas analysis, or electrolytic conductivity.



FOR MARVELOUS ABRASION RESISTANCE—
PHILBLACK O

FOR FURTHER DETAILS, SEE AD ON PAGE 638

CAPITOL LINER PROCESS

•

If the use of talc or soapstone causes dust and dirt in your plant, besides creating a health hazard, why not solve this problem as have many rubber concerns by using liners treated with our CAPITOL LINER PROCESS.

Take advantage of our trial run offer and convince yourself.

•

Send us 50 or 100 yards of liner material. We will treat it without charge and return for testing in your plant.

•

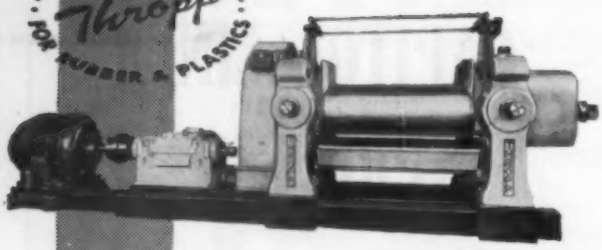
We *flameproof*, *mildewproof*, and *waterproof* cotton fabrics.

TEXTILE PROOFERS, INC.

181-193 Culver Ave., Jersey City 5, N. Y.

Originators of the Capitol Liner Process

"CUSTOM BUILT" Thropp FOR RUBBER & PLASTICS



New Hi-Speed MILLS

22" & 22"x60" Extra Heavy Duty

Extra Heavy Duty Individual Motor Driven Mill with 15" diameter journals, having 150 H.P. enclosed herringbone gear drive. Machine is equipped with solid bronze lined bearings having oil closure seals on side of the boxes facing the rolls to prevent oil contamination of the stock. Steel cut connecting gears and Johnson Rotary Joints. Manzel mechanical lubricator and new style guides bored to fit the rolls. This is just one of the many new Thropp precision built mills designed to speed up post war production.

West Coast Representative
H. M. Royal Inc.
Los Angeles, Cal.

Thropp

WM. R. THROPP & SONS CO.
Trenton, N. J.

The Perfect UTILITY OVEN

$98.50

Having a temperature range from 35 to 180° C., the "Precision"-Thelco No. 16 laboratory oven can be used for baking, drying, conditioning, preheating and many other applications in every laboratory. Particularly useful as a general purpose oven in large laboratories needing additional equipment to handle overflow work when all other cabinets are busy. The extremely low price of this unit plus its ruggedness and wide field of applications make it an "unusual value" for limited budgets. Write for four page brochure on "Precision"-Thelco equipment.

70

"PRECISION" THELCO MODEL NO. 16
Recorded proof of Control Accuracy

Reproduced at the right is a typical temperature control chart produced by a recording thermocouple showing accuracy of Model 16 oven. Note the straight band, providing thermostatic control accuracy and uniform width of band indicating temperature uniformity throughout working chamber—FEATURES NEVER OFFERED BEFORE IN A LOW PRICED OVEN.

See Your Laboratory Supply Dealer

Precision Scientific Company
3737 CORTLAND STREET CHICAGO 47, ILL., U.S.A.
Scientific Research and Production Control Equipment

Marsto-Chron Recording Instrument

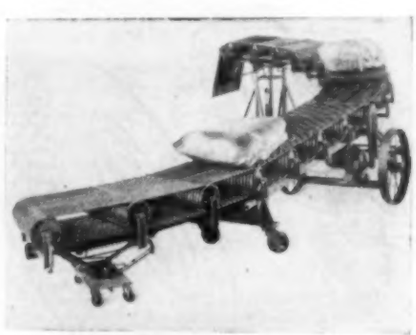
Black & Webster, Inc., 126 Massachusetts Ave., Boston, Mass., has placed on the market a new time and motion study recording instrument, called the "Marsto-Chron," which can be operated at 110 volts, 60 cycles A.C. The instrument is said to be applicable in work

simplification studies by method engineers and for evidence in labor relations where convincing proof of elapsed time is essential.

As soon as the toggle switch is actuated, the instrument's tape begins to travel. At the start of a work cycle, both type and bar keys are struck, printing two short horizontal lines on the tape. Elements in the work cycle are recorded by striking the right hand key. Interruptions in the normal cycle are tapped out with the left hand key. At the conclusion of the cycle both keys are again struck. When torn off on the built-in cutting edge, the tape is an accurate and permanent time record. The instrument is said to be twenty times faster than a stop watch study.

Flexoveyor Portable Conveyor

Flexoveyor is the name given to a new fast, efficient portable conveyor manufactured by the E. C. Horne Machinery Co., Denver 2, Colorado. The new conveyor moves bags and cartons to and from box cars and trucks, in units not heavier than 200 pounds, at a rate of approximately 1500 units per hour. It operates effectively around curves up to 90° and at a



maximum incline of 12°. The conveying medium consists of electric motor driven multiple endless steel springs operating over 6-inch diameter grooved rollers spaced at 20-inch intervals. Length of standard unit is 26 feet 8 inches, and width of 20 inches. Powered by 1 h.p. gear motor, with reversing switch.

NEW! IT
S-T-R-E-T-C-H-E-S!

Sensational New
BALING CLOTH
Cuts Labor Costs, Saves Up to 80% in Baling Time!

Jefco Jute Tubing, the new seamless, continuous, tubular baling cloth, conforms quickly and easily to packages of almost every size and shape. Its unique flexibility and elasticity speed production and cut shipping room costs . . . its durability and toughness protect your package. Write for details today.

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A product of THE J. E. FRICKE CO.
40 N. Front St., Phila. 6, Pa. • Mills at Hulmeville, Pa.

CONTINENTAL MACHINERY CO.
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Designers and Manufacturers of
RUBBER PLANT EQUIPMENT

- All types of Rubber Machinery and Plant Equipment for every requirement of Large and Small Factories.
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- Specialists in Latex Equipment.
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Choose ROYLE
RUGGED - ADAPTABLE
DEPENDABLE

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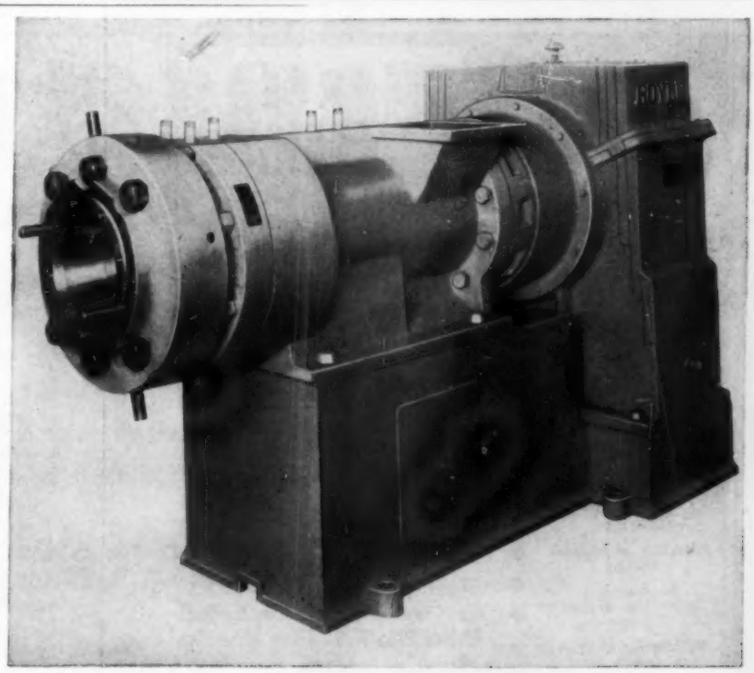

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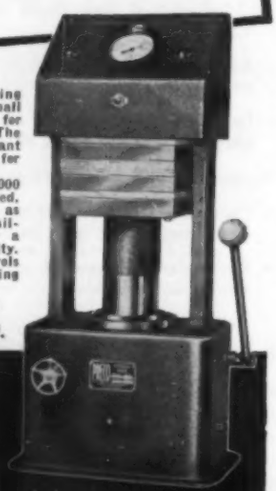

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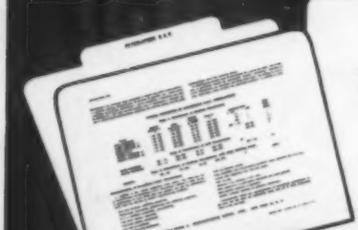

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Evaluating the Processibility of Rubber

(Concluded from Page 710)

wartime rubber program. In the preparation of this paper much use has been made of these reports from different laboratories. An attempt has been made to give credit where possible but it is quite probable that this attempt has fallen short of the authors' intentions.

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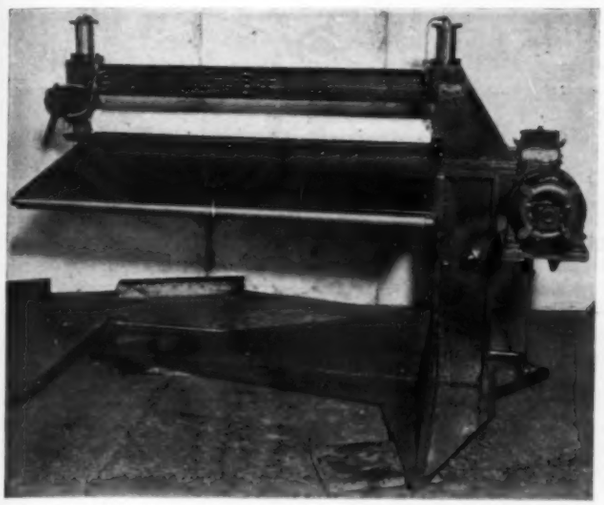

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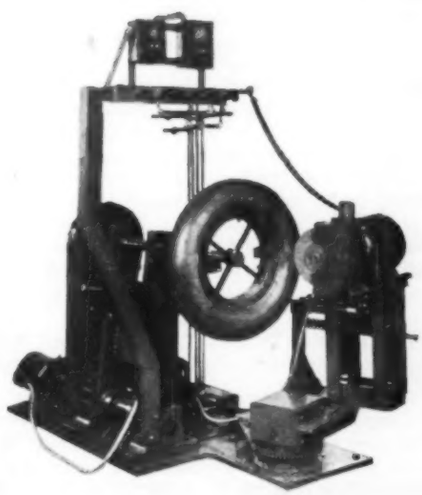

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REVIEWS

BOOKS

Compounding Ingredients for Rubber (Second Edition). Published by the India Rubber World, 386 Fourth Ave., New York 16, N. Y. 6 x 9 in. 640 pp. Price: U. S. A., $5.00; Elsewhere, $6.00

This second edition of "Compounding Ingredients" is a vast improvement over the first one, published in 1937. Not only does it contain data on some 2,000 separate products, as compared with less than 500 in the first edition, but it has been extended to include a section on raw materials, this section covering natural and synthetic rubbers and their latices, as well as synthetic resins and latices. This addition was dictated by the fact that the rubber compounder now uses all of these raw materials.

The present edition is divided into three sections, as follows: (1) Dry Rubber Compounding Materials; (2) Latex Compounding Ingredients; and (3) Raw Materials. Like the first edition, comprehensive data is supplied on each of the materials listed, including composition, supplier, properties, types of rubber or resin in which used, function, and recommended applications. Explanatory notes precede the various sections, while general articles on the raw materials, such as natural rubber and synthetic rubber, are included. Each of the major sections are subdivided into groups and sub-groups.

The book includes a complete list of suppliers and addresses, as well as a product and function index. It should prove a valuable addition to every rubber library.

●

The Story of Rubber. By Dr. Richard J. Tudor. Published by the Burke Publishing Co., Ltd., 6 Carmelite St., London, E. C. 4, England. 7 x 9½ in. 96 pp.

Fourth in a new series of popular informational books designed to meet the growing need for authoritative literature covering all aspects of Britain's industrial achievement, this book, as indicated by its title, covers rubber. The text is nontechnical and is intended for the general reader rather than the specialist. For the scientifically inclined, however, there is a summary of synthetic rubber developments. A comparison between the various synthetic rubbers and the natural product is drawn by the author. The book is several shades above those intended for youngsters and students and does a good job of acquainting the reader with rubber and its applications. The text is ably abetted by an excellent series of photographs, depicting actual processing operations. The author, Dr. Tudor, won the President's Prize for work on Synthetic Rubber Processing organized by the Institute of the Rubber Industry.

●

Developments in Rubber. Published by the Andre Rubber Co., Ltd., Kingston By-Pass, Surbiton, Surrey, England. 6¼ x 8¾ in. 154 pp.

This book is composed of a number of individual papers recording some of the work done in the laboratories of the Andre Rubber Co. and published in various scientific journals. It includes papers on the bonding of rubber to metal, physical examination of brass deposits, chemical nature of the rubber-to-brass bond, bonded rubber for machinery mountings, rubber in electroplating, testing methods for metal-bonded rubber, calculation relating to the Goodrich Flexometer, and new methods of molding. In its handbook entitled "Elastomeric Engineering" (RUBBER AGE, December, 1946, p. 368) the company furnished a survey of modern methods for manufacturing rubber units for mechanical purposes. The present book can be regarded as complementary to "Elastomeric Engineering" in that it emphasizes to a greater extent the scientific background. It was prepared for distribution to the company's customers.

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The book contains a wealth of historical, commercial and some technical data of interest and value to the rubber manufacturer as well as to the student and others interested in the subject of rubber reclaiming.

CONTENTS

1. Early History; 2. Mitchell and the Acid Process; 3. Marks and the Alkali Process; 4. Miscellaneous Reclaiming Processes; 5. Companies and Associations; 6. Scrap Rubber; 7. Manufacture; 8. Properties and Uses; 9. Statistics; 10. World War II. Epilogue. Bibliography. Index.

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REVIEWS (CONT'D)

Coating and Ink Resins. By Dr. William Krumbhaar. Published by the Reinhold Publishing Corp., 330 West 42nd St., New York 18, N. Y. 6 x 9 in. 318 pp. $7.00.

The scope of this book is limited to those types of coating and ink resins which are now in common use. No reference is made to elementary chemistry, chemical equations or elaborate structural formulae, but the theoretical background of the chemistry and physics of the resinous materials is supplied, as far as such conceptions can be supported by experimental evidence. The text is confined to the light colored, hard, soluble and high viscosity groups of phenolic, maleic, and copal type of synthetics, all of which show interesting chemical reactivities when incorporated into surface coatings and printing inks. The book is divided into ten chapters, including those on the influence of resins on surface coatings and on printing inks. Other chapters cover the application of the resins and machinery and equipment. A discussion of the patent situation is also included.

•

Small Wonder: The Story of Colloids. By Gessner G. Hawley. Published by Alfred A. Knopf, Inc., 501 Madison Ave., New York, N. Y. 5½ x 8½ in. 230 pp. 57 Illustrations. $3.50.

This book offers the first full-length discussion of a new science in terms the layman can understand. It is a brief, simple statement of the fundamental principles, the problems, and the achievements of colloid science to date. The author explains the nature and characteristics of many important plastics, foods, glue, soap, etc., of many vital bodily structures and functions, and of such industrial processes as the treatment and purification of water and sewage, the processing of crude oil, and the homogenization of milk. A book of this nature must invariably refer to rubber and latex, and comments on these materials are scattered throughout the pages. What colloids are and why they behave as they do is described in non-technical language.

•

Directory of American Council of Commercial Laboratories. Published by the Council. 8½ x 10¾ in. 40 pp.

Data pertaining to the personnel and services of each of the members of the American Council of Commercial Laboratories is contained in this directory, one page being devoted to each organization. Excerpts from the by-laws of the Council, organized in 1937, are included to give the user of the directory a specific idea with regard to its objectives. Copies of the directory can be secured without cost from A. L. Brassell, Vice-President, U. S. Testing Co., Inc., Hoboken, N. J.

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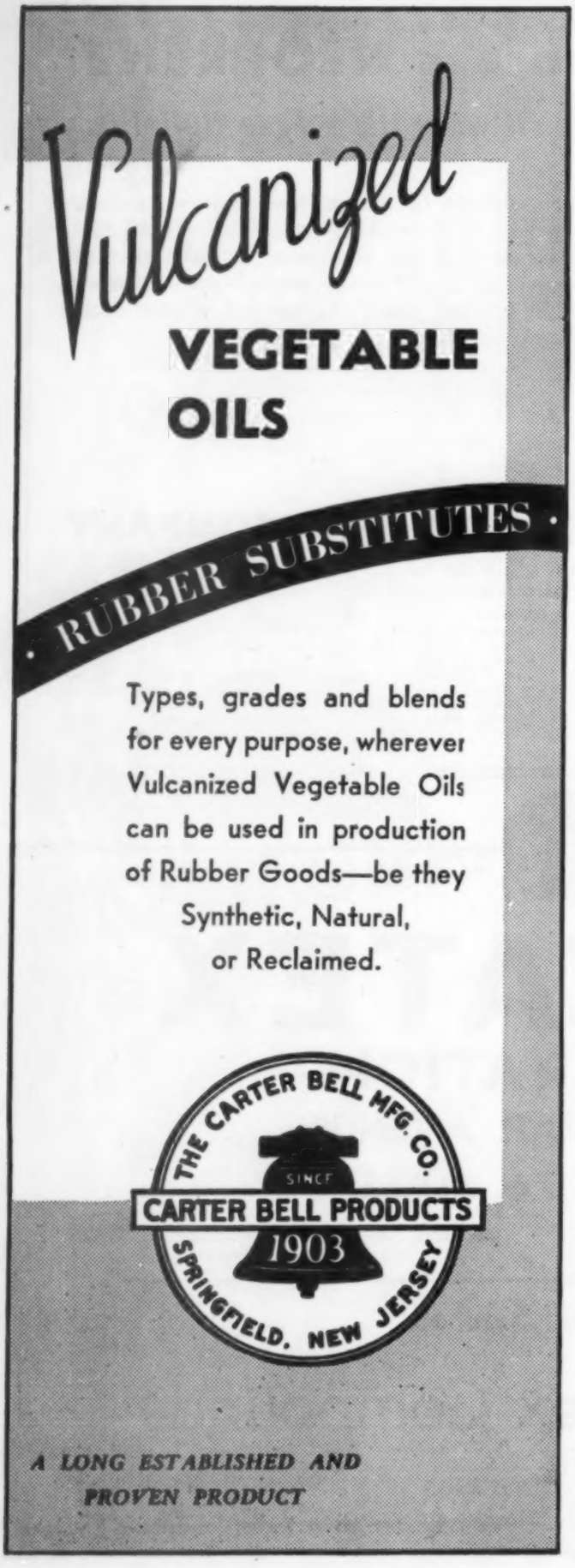
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Phthalic Anhydride. Barrett Division, Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y. 8½ x 11 in. 54 pp.

This comprehensive booklet contains valuable technical data concerning phthalic anhydride, its derivatives, and its applications. Supplemented by numerous charts, tables and photographic illustrations, it presents detailed information on the physical and chemical properties, purity and performance of this increasingly important product. One section of the booklet is devoted to phthalic anhydride testing methods. A comprehensive list of products and application of the material is presented as an indication of its diversity, and major uses in the manufacture of synthetic resins and plasticizers are described, with a number of formulations being shown. An extensive bibliography is included.

•

Directory of Research and Development Facilities at Educational Institutions in New York State. New York State Department of Commerce, 112 State St., Albany 7, N. Y. 8½ x 11 in. 84 pp.

Sources of technical assistance available at New York State educational institutions to industries in the State having special production or other technical problems are listed for the first time in this new directory. Research laboratories, specialized personnel, and technical facilities are briefly described. A feature of the directory is a simplified chart of facilities for research and laboratory analysis at twenty-six universities and colleges and fifty-eight technical subjects on which specialized research is available. The facilities available at private commercial laboratories or services of consultant engineers, chemists, and physicists are not given.

•

Chemical Facts and Figures. (Second Edition). Published by the Manufacturing Chemists' Association of the United States, 608 Woodward Bldg., Washington 5, D. C. 8 x 10½ in. 410 pp. $2.00.

The second edition of this statistical yearbook includes all significant chemical statistics published by official agencies since 1940. Factual data, graphs and statistics relate to organic and inorganic chemical production, sales, wholesale price, foreign trade, research, employment, wages, finance, taxes, safety, minerals, and production and sales of all allied products, including synthetic rubber, plastics, and fertilizer materials. A complete and detailed index is included.

•

Mikro-Pulverizer and Mikro-Atomizer. Pulverizing Machinery Co., Chatham Road, Summit, N. J. 8½ x 11 in. 56 pp.

The basic principles, construction and application of the company's pulverizing equipment are described and illustrated in this new catalog. Particular attention is paid to the Mikro-Atomizer, which produces microscopically fine powders far beyond the ability of even the Mikro-Pulverizer in its own logical applications. The test grinding and research facilities offered by the company are also outlined in the catalog.

•

Rubber Cement Mixers. (Bulletin No. 55-W). Struthers Wells Corp., Warren, Penna. 8½ x 11 in. 4 pp.

Descriptions and illustrations of the company's rubber cement mixers, which combine a marine propeller agitator with a streamlined mixing tank, are contained in this bulletin. A special feature of the bulletin is easy-to-read constructional diagrams which show all parts of both the one and two agitator models. Tables which contain working capacities and complete dimensions of the mixers are provided for use with the diagrams.

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REVIEWS (CONT'D)

Northmaster Intensive Mixers. Struthers Wells Corp., Titusville, Penna. 8½ x 11 in. 8 pp.

Illustrated in color, this bulletin furnishes data on the company's mixers, which are used in the compounding, plasticizing, and processing of natural and synthetic rubber, reclaimed rubber, plastics, and other tenacious materials. Photographs and illustrations are employed to show simply and concisely how the Northmaster mixers operate. Nine exclusive construction features of the mixers, which are said to contribute to more practical operation and higher efficiency, are described. A table of standard sizes and ratings is included.

•

Adhesion of Fibers to Elastomers. (Report No. 47-4). By H. H. Abernathy and R. R. Radcliff. Rubber Chemicals Division, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. 6¼ x 9½ in. 24 pp.

This report discusses adhesives which are used for bonding natural or synthetic fibers, such as cotton, rayon and nylon, to various elastomeric compounds. The report is divided into two parts, the first covering aqueous adhesives (latices) and the second non-aqueous adhesives containing MDI-50. Numerous formulas are given and the physical test results of some of these are shown.

•

Quimby Close Coupled Centrifugal Pumps. (Bulletin No. 300A). Quimby Pump Division, H. K. Porter Co., Inc., Pittsburgh 22, Penna. 8½ x 11 in.

This bulletin describes and illustrates the close coupled centrifugal pumps manufactured by the company. Construction features of the casing, impeller, stuffing box, pipe connections, motor, and bearings of two types of pumps are covered. To avoid duplication, dimensions are given separately for various pumps and motors, and selection tables are included for fifty and sixty cycle speed pumps for cold water and brine.

•

Zyrox Brand Saturants for Wire Insulation. Bakelite Corp., 30 East 42nd St., New York 17, N. Y. 8½ x 11 in. 16 pp.

This booklet gives the chemical, physical and electrical properties of the Zyrox compounds available for treating fibrous materials used in the insulating of electrical wires and cables. The forms of these saturants, which are essentially non-toxic chlorinated hydrocarbon synthetic condensation products, are also discussed. Other subjects covered include compound evaluation, equipment design, and principal commercial applications.

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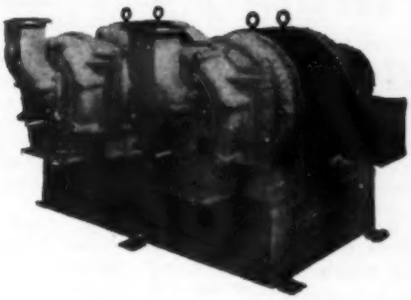

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MARKETS

Rubber – Crude, Reclaimed and Scrap – Cotton – Ducks – Tire Fabrics – Sheetings

NEW YORK, SEPT. 15, 1947

Natural Rubber

Prices for spot rubber on the Commodity Exchange have moved in a 138 point range since our last report (August 14), low being 15.00 cents on August 18 and the high of 16.38 cents being touched on September 10, 11 and 12. The price has moved steadily upward due to a number of factors, among them being the latest revision of Rubber Order R-1, freeing the use of natural rubber in all non-transportation items, entrance of the U. S. Treasury Department into the market for 10,000 tons of stockpile rubber, and strong developments in outside markets, particularly major commodities.

Rubber circles were interested in the postwar rubber production plan launched by Brazil on September 8 when a law was signed guaranteeing producers a minimum price of approximately 45 cents per pound until December 31, 1950. The law requires delivery of rubber to warehouses at Belem. Most of the rubber procured under the new subsidy arrangement will be used for Brazil's internal transportation and industrial needs, especially in the manufacture of tires and tubes.

The case of the *S. S. Martin Behrman*, which stirred shipping circles several months ago, is far from over. The Isbrandtsen Co., American ship owners, have filed suit in an American court against the Netherlands East Indies Government and the Netherlands Government for $3,084,241. The suit charges Dutch authorities in Cheribon, Java, with illegal seizure of the American ship and confiscation of its cargo, including rubber.

Today's quotations in the outside market, London and Singapore, follow:

Outside Market

No. 1 Ribbed Smoked Sheets:	
Spot	.16⅝
September	.16⅝
October-December	.16½
Thick or Thin Latex Crepe:	
Spot	.30½
October-December	.29½
Thin Brown Crepe, No. 2	.13¾
Ambers, No. 3	.13¾
Flat Bark Crepe	.12

London Market

(Standard Smoked Sheets)

October-December	16.16 - 16.27
January-March	16.16 - 16.27
April-June	16.16 - 16.27

Singapore Market*

(Standard Smoked Sheets)

September	14.27 - 14.37

Synthetic Rubber

(Dry Types)

Butaprene NXM	.470 - .495
Chemigum 30 N4NS	.400 - .470
Chemigum 50 N4NS	.400 - .470
Chemigum N3	.450 - .520
Hycar OR-25	.400 - .425
Hycar OR-15	.470 - .495
Hycar OS-10	.400 - .425
Neoprene Type E	—— - .650
Neoprene Types CG and AC	—— - .500
Neoprene Types FR and KNR	—— - .750
Neoprene Type S	—— - .320
Neoprene Type NC	—— - .250
Perbunan 18	.390 - .415
Perbunan 26	.400 - .425
Perbunan 35	.470 - .495
Thiokol Type A	.370 - .470
Thiokol Type ST	.750 - .850
Thiokol Type FA	.520 - .620
Thiokol PR-1	.750 - .850

Scrap Rubber

With reclaimers still in a satisfactory position with regard to inventory, the scrap rubber market continues stagnant with prices largely a matter of guess-work. Few shipments are moving, although some peelings have been bought for approximately $42.50 a ton delivered for the No. 1 grade. In one area, mixed auto tires have been bought for as low as $10.00 per ton, although the broker's price is above that figure. Few quotations are being made and the prices shown below are those which were in effect several months ago:

(Prices to Consumers, Delivered Akron)

Mixed passenger tires	ton	$18.00
Beadless truck tires	ton	24.00
Mixed truck tires	ton	18.00
Beadless passenger tires	ton	24.00
No. 1 passenger peelings	ton	50.00
No. 1 truck peelings	ton	50.00
No. 2 passenger tubes	lb.	.07½
Red passenger tubes	lb.	.07½
Black passenger tubes	lb.	.06½
Mixed passenger tubes	lb.	.06¼
No. 2 truck tubes	lb.	.07¼
Red truck tubes	lb.	.07
Black truck tubes	lb.	.07
Buffings	ton	18.00

Reclaimed Rubber

For the first time in the past several years the supply of reclaimed rubber is more freely available. The tapering off in demand was first noticeable in July, due to vacation periods, inventory shut-downs, and the like, plus the curtailment of tire production. Reclaimers are confident, however, that demand will increase during the last quarter of the year and are maintaining full production schedules. There have been no changes in prices since our last report.

Tires				
Black, Acid	lb.	.08¼	@	.09¼
Black, Digester	lb.	.08	@	.08½
Peels	lb.	.09	@	.09½
GR-S Whole Tire	lb.	.08½	@	.09
Inner Tubes				
Black	lb.	.12¾	@	.13¼
Red	lb.	.13½	@	.14
GR-S	lb.	.09½	@	.10
Butyl	lb.	.08½	@	.09
Shoe				
Unwashed	lb.	.08¼	@	.08¾

Cotton Tire Fabrics

The demand for cotton tire fabrics and chafers has waned considerably in the past few months. There have even been reports of offerings of such materials on the part of some tire manufacturers who obviously did some over-purchasing. Demand for large quantities is reported from the export market but there are innumerable construction difficulties in meeting this demand. There has been no change in the price structure for the past few months.

Standard, Peeler, 12/4/2	lb.	.7400
Standard, Peeler, 14/4/2	lb.	.7600
Standard, Peeler, 16/4/3	lb.	.7850
Extra Staple, Peeler 12/4/2	lb.	.8375
Extra Staple, Peeler, 14/4/2	lb.	.8575
Extra Staple, Peeler, 16/4/3	lb.	.8825

Chafers

14.4 oz. (per sq. yard)	lb.	.7150
9.25 oz. (per sq. yard)	lb.	.7450
11.65 oz. (per sq. yard)	lb.	.6450
8.9 oz (per sq. yard)	lb.	.6900

Cotton

The price of middling uplands on the Cotton Exchange has swung in the wide range of 365 points since our last report (August 14), high for the period being 35.40c on August 15 and low 31.75c on September 8. Indicating the erratic behavior of the market, the low for the present period of 31.75 is 843 points below the record high of 40.18c reached on July 16 last. The average price of middling uplands for the month of August was 34.83, based on 21 trading days.

The price declined steadily from mid-August until September 8, due to a number of disturbing factors. It strengthened thereafter following the prediction of the Department of Agriculture that cotton production this year will amount to 11,849,000 bales. This prediction was based on September 1 crop conditions and compares with the 1946 production of 8,640,000 bales and the 1936-45 average of 12,390,000 bales. The trade had previously estimated the 1947 crop to be well over 12,000,000 bales.

Trade circles predict that the price will soon move to between 33 and 34 cents a pound and will probably settle at that level. If the price moves higher, there is a strong possibility that higher margins will be required for cotton trading as it has for grain. Quotations for middling uplands on the Exchange follow:

	Aug. 13	Sept. 15		
	Close	High	Low	Close
October	32.75	32.42	31.64	32.31
December	32.39	32.15	31.33	32.13
March	32.30	32.20	31.29	32.20

Closing Rubber Prices on New York Commodity Exchange

FROM AUGUST 15 TO SEPTEMBER 15

Date		Spot	Sept.	Dec.	March	May
Aug.	15	15.25	15.20	14.95	14.80	14.75
	16	——	——	——	——	——
	17	——	——	——	——	——
	18	15.00	15.30	14.85	14.80	14.75
	19	15.50	15.60	15.10	15.05	15.00
	20	15.50	15.60	15.25	15.20	15.10
	21	15.25	15.40	15.10	15.00	14.90
	22	15.25	15.30	15.00	14.95	14.90
	23	——	——	——	——	——
	24	——	——	——	——	——
	25	15.25	15.25	15.00	14.95	14.90
	26	15.25	15.00	14.85	14.80	14.70
	27	15.25	15.05	14.90	14.85	14.70
	28	15.00	15.05	14.72	14.72	14.72
	29	15.25	15.45	15.05	15.05	15.00
	30	——	——	——	——	——
	31	——	——	——	——	——
Sept.	1	——	——	——	——	——
	2	15.38	15.40	15.00	14.95	14.90
	3	15.50	15.65	15.30	15.25	15.10
	4	15.75	15.80	15.30	15.20	15.15
	5	15.88	15.80	15.60	15.45	15.40
	6	——	——	——	——	——
	7	——	——	——	——	——
	8	16.00	16.05	15.65	15.50	15.40
	9	16.13	16.20	15.90	15.85	15.75
	10	16.38	16.40	16.20	16.00	15.95
	11	16.38	16.35	16.10	15.85	15.80
	12	16.38	16.20	16.05	15.80	15.75
	13	——	——	——	——	——
	14	——	——	——	——	——
	15	16.50	16.40	16.25	16.00	15.95

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STATISTICS *Of Interest to the Rubber Industry*

U. S. Imports and Re-Exports of Natural Rubber

	GROSS IMPORTS											
	Natural Rubber (Dry)			Natural Rubber (Latex)			Guayule					
Year	Long Tons	Total Declared Value	Average Declared Value per pound Cents	Long Tons	Total Declared Value	Average Declared Value per pound Cents	Long Tons	Total Declared Value	Average Declared Value per pound Cents	Total Gross Imports Long Tons	RE-EXPORTS Long Tons	RE-EXPORTS Total Declared Value	TOTAL NET IMPORTS Long Tons
1936	467,064	152,072,496	14.54	19,852	6,659,899	14.98	1,229	286,552	10.41	488,145	12,581	4,488,223	475,564
1937	574,600	237,307,041	18.44	23,185	10,213,670	19.67	2,694	745,873	12.36	600,479	7,902	3,385,433	592,577
1938	397,620	125,357,730	14.07	11,878	4,147,318	15.59	2,485	623,819	11.21	411,983	5,652	1,799,124	406,331
1939	469,803	167,558,245	15.92	27,438	10,467,552	17.03	2,232	463,345	9.27	499,473	13,125	5,832,618	486,348
1940	780,820	303,117,726	17.33	33,789	14,593,466	19.28	3,634	758,007	9.31	818,243	7,060	3,197,136	811,183
1941	989,329	401,890,393	18.14	34,798	15,965,627	20.48	4,881	1,145,767	10.48	1,029,008	5,376	2,757,872	1,023,632
1942	265,980	112,377,896	18.86	10,646	5,630,667	23.61	5,523	1,660,792	13.42	282,149	10,856	5,913,386	271,293
1943	30,348	31,364,033	27.81	1,890	1,312,202	30.99	7,679	3,636,789	21.14	59,917	22,587	16,446,707	37,330
1944	103,820	73,908,389	31.78	3,091	2,092,211	30.22	6,700	3,351,233	22.33	113,611	9,739	8,712,695	103,872
1945	134,454	95,850,441	31.82	4,773	3,115,853	29.14	10,040	5,963,797	26.52	149,267	9,509	7,201,746	139,758
1946	366,415	222,552,939	27.12	8,421	5,843,085	30.98	5,344	2,859,246	23.89	380,180	7,711	5,331,954	372,469
1945:													
Sept.	9,870	7,050,795	31.89	626	408,651	29.15	668	409,535	27.38	11,164	406	310,128	10,758
Oct.	10,673	7,645,618	31.98	287	187,422	29.15	646	391,971	27.07	11,606	562	369,296	11,044
Nov.	11,177	7,844,162	31.33	296	193,252	29.15	739	446,925	27.65	12,212	254	179,321	11,958
Dec.	12,844	9,273,507	32.24	382	248,604	29.15	819	498,604	27.20	14,045	525	349,385	13,520
1946:													
Jan.	18,580	13,515,971	32.48	569	371,857	29.15	446	263,279	26.33	19,595	164	41,992	19,431
Feb.	32,690	23,944,266	32.70	....	.....	....	318	171,823	24.10	33,008	723	444,400	32,285
Mar.	31,093	22,520,391	32.33	504	328,905	29.15	160	87,344	24.34	31,757	714	488,044	31,043
Apr.	26,234	18,997,757	32.33	1,001	808,463	36.06	874	467,151	23.86	28,109	392	243,952	27,717
May	4,784	3,314,818	30.93	1,052	687,100	29.11	430	219,830	22.82	6,266	422	419,278	5,844
June	8,518	6,132,895	32.15	561	366,165	29.15	466	244,580	23.41	9,545	4 0	446,253	9,085
July	20,641	13,947,817	30.47	696	451,593	28.96	291	148,442	22.85	21,628	2,457	1,600,600	19,171
Aug.	34,125	18,656,966	24.41	1,231	803,435	29.14	366	193,680	23 06	35,722	1,515	902,005	34,207
Sept.	41,311	22,317,275	24.12	....	.. ..	....	425	219,849	23.09	.....	145	81,481	.....
Oct.	45,573	24,745,403	24.27	672	438,938	29.15	691	377,319	24.38	46,886	649	613,424	46,237
Nov.	58,756	30,648,620	23.29	130	85,363	29.24	379	200,270	23.58	59,265	60	29,800	59,205
Dec.	44,159	23,810,760	23.87	2,005	1,501,336	33.43	494	265,679	24.02	46,658	17	20,625	46,641
1947:													
Jan.	92,459	51,035,472	24.64	....	.....	....	315	169,081	23.65	.....	20	16,644	.....
Feb.	57,771	30,580,942	23.63	2,476	1,550,499	28.52	481	256,760	23.84	60,678	1,991	1,149,953	58,687
Mar.	35,128	19,421,550	24.46	496	324,103	29.15	463	246,573	23.76	36,087	39	23,592	36,048
Apr.	45,453	21,627,600	23.21	34	26,754	34.84	574	282,941	24 09	46,011	26	20,725	45,985
May	91,918	47,208,658	22.93	763	442,050	25.87	345	186,201	24.11	93,026	14	9,169	93,012
June	62,346	28,339,739	20.29	2,825	1,642,417	25.95	554	298,705	24.07	65,725	....	.....	.....

Source: U. S. Department of Commerce.
Notes: (1) Figures for latex are on a dry weight basis. (2) Figures for re-exports include natural rubber (dry and latex) and guayule.

Natural Rubber
(Including Latex and Guayule)
(All Quantities in Long Tons)

Year	New Supply	Consumption	Re-Exports	Stocks On Hand at End of Period
1936	488,145	575,000	12,581	223,000
1937	600,479	543,600	7,902	262,204
1938	411,983	437,031	5,652	231,500
1939	499,473	592,000	13,125	125,800
1940	818,243	648,500	7,060	288,864
1941	1,029,007	775,000	5,376	533,344
1942	282,653	376,791	10,856	422,714
1943	55,329	317,634	20,815	139,594
1944	107,834	144,113	9,665	93,650
1945	135,672	105,479	6,743	118,715
1946	400,687	277,597	4,338	237,467
1945:				
Aug.	10,259	7,392	777	105,594
Sept.	12,150	5,799	560	111,385
Oct.	13,984	7,206	78	118,085
Nov.	7,288	7,575	255	117,543
Dec.	7,884	8,185	92	118,715
1946:				
Jan.	25,143	10,355	209	133,294
Feb.	35,104	10,131	290	157,977
Mar.	35,348	12,792	445	180,088
Apr.	19,847	16,914	190	182,831
May	6,126	17,867	327	170,763
June	23,382	16,466	911	176,768
July	14,942	21,998	222	169,490
Aug.	45,087	28,405	502	185,590
Sept.	46,122	31,123	988	199,591
Oct.	36,735	35,421	106	200,799
Nov.	55,231	37,323	35	218,672
Dec.	57,620	38,802	23	237,467
1947:				
Jan.	102,080	45,328	43	294,191
Feb.	30,318	40,983	1,253	283,479
Mar.	40,437	43,104	509	280,812
Apr.	55,976	43,818	....	292,970
May	89,738	43,018	....	330,960
June	57,055	42,529	311	345,175
July	57,243	40,284	421	141,352*

Source: 1936-40, U. S. Department of Commerce; 1941 to date, Civilian Production Administration. *Available to industry.

U.S. Gross Imports of Balata, Jelutong, Gutta-Percha, etc.
(All Quantities in Long Tons)

	Balata		Jelutong		Gutta-Percha & Other Guttas	
Year	Tons	Value	Tons	Value	Tons	Value
1936	535	199,368	6,163	1,296,364	1,568	555,643
1937	354	151,344	7,109	2,017,786	1,122	440,894
1938	509	181,140	9,132	2,944,504	444	204,582
1939	694	265,553	6,640	1,603,418	1,740	539,255
1940	648	300,500	7,451	2,449,137	2,340	1,004,885
1941	924	489,514	8,821	2,954,001	1,783	607,025
1942	1,544	1,107,059	1,200	530,296	804	525,763
1943	1,047	708,701	35	14,840	..	.....
1944	1,012	660,805	88	45,578	10	4,999
1945	1,361	907,253	....	.....	36	21,970
1946	2,281	2,233,065	304	256,169	423	458,064
1945:						
Aug.	154	80,296	....	.....	....	.....
Sept.	49	52,148	....	.....	5	2,196
Oct.	130	83,173	....	.....	....	.....
Nov.	303	257,246	....	.....	10	6,547
Dec.	48	58,742	....	.....	18	9,983
1946:						
Jan.	129	121,228	....	.....	....	.....
Feb.	38	35,699	....	.....	5	2,178
Mar.	100	70,315	....	.....	....	.....
Apr.	362	261,098	....	.....	....	.....
May	325	212,899	....	.....	....	.....
June	80	80,006	....	.....	....	.....
July	219	178,564	115	91,412	7	19,839
Aug.	234	249,380	....	.....	4	13,438
Sept.	159	161,937	4	9,337	23	47,147
Oct.	282	367,393	21	29,307	305	216,901
Nov.	152	270,379	28	39,502	3	10,233
Dec.	199	287,167	57	41,757	26	52,096
1947:						
Jan.	183	252,580	37	29,087	36	71,252
Feb.	270	300,878	36	44,679	17	39,679
Mar.	137	158,530	190	112,132	21	28,898
Apr.	85	106,783	178	86,923	31	48,178
May	212	208,440	524	259,745	86	164,611
June	76	63,612	83	37,314	47	88,420

Source: U. S. Department of Commerce.

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AKRON 9, OHIO

Synthetic Rubber

(GR-S, Neoprene, Butyl, and Buna N Types)

(All Quantities in Long Tons)

Year	Production	Imports	Consumption	Exports	Stocks On Hand at End of Period
1941	8,383	.....	6,259	572	1,702
1942	22,434	.....	17,651	1,419	4,612
1943	231,722	.....	170,891	18,148	41,568
1944	762,630	11,043	566,670	104,266	142,927
1945	820,373	10,407	693,580	83,778	203,454
1946	740,026	7,709	761,699*	72,920	114,963
1946:					
Jan.	56,089	.....	66,993	5,715	177,051
Feb.	51,848	.....	63,770	6,415	144,427
Mar.	60,363	1,429	74,214	17,707	115,310
Apr.	66,014	536	70,703	12,878	101,510
May	66,044	366	70,914	13,102	93,447
June	63,388	415	62,899	5,161	94,095
July	63,176	353	54,562	3,175	101,007
Aug.	64,300	634	61,486	2,175	103,076
Sept.	63,705	1,031	58,798	2,480	108,840
Oct.	62,086	1,149	60,729	474	110,913
Nov.	60,305	894	57,794	1,781	113,556
Dec.	62,648	902	53,453	1,857	114,963
1947:					
Jan.	62,103	0	58,764	3,359	115,655
Feb.	59,125	0	53,321	2,166	119,912
Mar.	57,478	0	55,514	704	121,322
Apr.	50,117	4	54,333	357	116,829
May	39,069	0	48,692	433	105,291
June	35,681	0	42,580	2,286	97,612
July	31,917	0	38,025	412	91,118

Source: Civilian Production Administration.

Notes: (1) These figures are revised from time to time and the latest available issue should be consulted for the most accurate data. (2) Figures shown include the output of both government and privately-owned plants. (3) Figures for 1941 are estimated. * Includes year-end adjustment of 5,384 tons to cover non-reporting companies.

Synthetic Rubber—By Type

(All Quantities in Long Tons)

New Supply

	GR-S (Buna S)	GR-M (Neoprene)	GR-I (Butyl)	Buna N Types	Total
1942	3,721	8,956	23	9,734	22,434
1943	182,259	33,603	1,373	14,487	231,722
1944	679,949	56,660	20,252	16,812	773,673
1945	724,859	45,672	52,378	7,871	830,780
1946	613,408	47,766	80,823	5,738	747,735

Consumption

1942	2,579	6,833	22	8,217	17,651
1943	131,977	26,205	304	12,405	170,891
1944	495,552	46,243	10,763	14,112	566,670
1945	600,145	42,394	43,012	8,029	693,580
1946	632,126	44,357	79,228	5,988	761,699

Exports

1942	222	1,037	.....	160	1,419
1943	14,937	2,540	40	631	18,148
1944	98,380	4,799	530	557	104,266
1945	76,555	5,837	980	406	83,778
1946	68,763	2,642	495	1,020	72,920

Stocks at End of Period

1942	1,050	1,786	4	1,772	4,612
1943	30,975	6,415	1,035	3,143	41,568
1944	116,130	11,739	9,892	5,166	142,927
1945	170,571	9,703	18,378	4,802	203,454
1946	81,483	10,470	19,478	3,532	114,963

Source: Civilian Production Administration.

Notes: (1) These figures are revised from time to time and the latest available issue should be consulted for the most accurate data. (2) Figures for GR-M and Buna N Types include production of privately-owned plants.

Gasoline Consumption

(In Thousands of Barrels of 42 Gallons)

	1940	1941	1942	1943	1944	1945	1946	1947
Jan.	40,370	46,190	49,216	36,085	47,540	52,008	51,186	57,119
Feb.	37,557	42,782	42,666	36,274	47,754	48,856	47,889	50,551
Mar.	44,607	49,572	50,820	41,586	52,263	55,364	56,801	59,947
Apr.	47,683	55,879	49,554	48,177	50,005	59,024	62,045	64,140
May	52,946	60,121	53,212	49,828	54,230	60,748	66,774	70,865
June	55,459	59,062	50,077	52,325	54,266	60,580	63,221	71,329
July	53,865	63,906	54,606	49,867	55,119	66,170	69,044	.....
Aug.	55,346	63,575	48,793	51,880	55,616	70,058	66,701	.....
Sept.	52,297	59,768	50,093	49,707	56,318	64,529	62,216	.....
Oct.	53,807	58,412	50,094	53,111	53,154	55,708	66,598	.....
Nov.	49,074	54,670	50,729	50,703	54,967	53,543	61,315	.....
Dec.	46,413	53,568	39,250	48,695	52,250	49,745	61,043	.....
Total	589,424	667,505	589,110	568,238	633,482	696,333	734,833	.....

Source: U. S. Bureau of Mines.

Reclaimed Rubber

(Including Natural and Synthetic)

(All Quantities in Long Tons)

Year	Production	Consumption Tons	Consumption % to Crude [a]	Exports	Stocks On Hand at End of Period
1936	150,571	141,486	24.6	7,085	19,000
1937	185,033	162,000	29.8	13,233	28,800
1938	122,400	120,800	27.6	7,403	23,000
1939	186,000	170,000	28.7	12,611	25,250
1940	208,971	190,244	29.3	11,347	32,636
1941	274,202	251,231	32.2	13,851	41,750
1942	286,007[b]	254,820	64.6	30,405	42,532
1943	304,058[c]	291,082	59.6	15,678	46,201
1944	260,631[d]	251,083	35.3	11,800	43,832
1945	243,309	241,036	30.2	13,413	28,155
1946	295,612	275,410	26.5	14,461	33,666
1945:					
Dec.	20,632	19,590	30.5	1,391	28,155
1946:					
Jan.	24,458	22,031	28.5	1,253	29,099
Feb.	23,187	20,702	28.0	1,368	30,216
Mar.	25,136	22,075	26.0	1,841	31,436
Apr.	23,930	22,396	25.8	1,238	31,732
May	25,322	22,162	24.9	1,338	33,554
June	24,882	21,725	27.4	1,416	35,295
July	22,619	21,350	27.9	961	35,603
Aug.	25,798	24,566	27.3	1,093	35,742
Sept.	23,956	23,715	26.4	579	35,404
Oct.	26,322	26,706	27.7	759	34,261
Nov.	24,748	24,385	25.6	1,108	33,516
Dec.	25,254	23,597	25.6	1,507	33,666
1947:					
Jan.	25,545	27,715	26.6	1,443	30,053
Feb.	23,990	25,484	27.3	1,142	27,417
Mar.	26,209	26,157	26.8	1,268	31,940
Apr.	26,696	25,066	25.5	1,073	33,527
May	25,408	21,908	23.1	1,271	37,145
June	24,144	21,283	25.0	1,200	39,598
July	21,449	21,025	26.8	1,052	40,092

Source: 1936-40, Department of Commerce; 1941 to date, Civilian Production Administration.

Notes: (1) These figures are revised from time to time and the latest available issue should be consulted for the most accurate data. [a] Includes natural and synthetic rubber. [b] Includes 893 tons of imports. [c] Includes 67 tons of imports. [d] Includes 21 tons of imports.

Automobile Production in U. S.

(Civilian Production Only)

Year	Passenger Cars	Trucks	Total	Year	Passenger Cars	Trucks	Total
1930	2,784,745	571,241	3,355,986	1939	2,866,796	704,308	3,571,104
1931	1,973,090	416,648	2,389,738	1940	3,692,328	721,637	4,413,965
1932	1,135,491	235,187	1,370,678	1941	3,744,300	875,381	4,619,681
1933	1,573,512	346,545	1,920,057	1942	220,814	133,083	353,897
1934	2,177,919	575,192	2,753,111	1943	0	4,501	4,501
1935	3,252,244	694,690	3,946,934	1944	0	124,819	124,819
1936	3,669,528	781,862	4,451,390	1945	83,792	313,643	397,435
1937	3,915,889	892,382	4,808,271	1946	2,148,677	930,739	3,079,416
1938	2,000,985	485,852	2,486,837				
1946							
Jan.	56,367	45,033	101,400	July	209,180	87,591	296,771
Feb.	57,784	34,914	92,698	Aug.	247,261	97,881	345,142
Mar.	85,810	37,636	123,446	Sept.	232,280	95,658	327,938
Apr.	132,631	80,762	213,393	Oct.	283,586	107,154	390,740
May	166,942	75,373	242,315	Nov.	269,081	100,892	369,973
June	141,090	60,038	201,128	Dec.	266,665	107,616	374,281
1947							
Jan.	246,605	99,818	346,423	July	279,459	97,818	377,277
Feb.	267,015	105,042	372,057	Aug.	.....	.....	.....
Mar.	301,525	118,234	419,759	Sept.	.....	.....	.....
Apr.	314,765	106,984	421,749	Oct.	.....	.....	.....
May	284,357	96,430	380,787	Nov.	.....	.....	.....
June	307,124	91,810	398,934	Dec.	.....	.....	.....

Source: Automobile Manufacturers Association.

Note: Figures are based on factory sales. Revisions are made from time to time in these figures and the latest issue should be consulted for accuracy.

Rim Production

	1941	1942	1943	1944	1945	1946
Passenger Car	17,828,994	1,025,880	780,291	1,748,917	4,504,368	15,058,469
Truck & Bus	6,464,725	5,298,603	4,949,004	6,391,441	6,486,652	5,939,244
Agricultural	1,576,720	194,900	301,997	997,301	1,441,909	1,735,992
Earth Mover	2,593	1,814	945	703	1,308	5,520
Total	25,873,032	6,521,197	6,032,237	9,138,362	12,434,237	22,739,225

	1947 July	Aug.	Sept.	Oct.	Nov.	Dec.
Passenger Car	1,665,587	1,482,922	.....	.....	.....	.....
Truck & Bus	599,064	571,236	.....	.....	.....	.....
Agricultural	177,163	181,107	.....	.....	.....	.....
Earth Mover	1,751	775	.....	.....	.....	.....
Total	2,443,565	2,236,040	.....	.....	.....	.....

Source: The Tire & Rim Association, Inc.

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CONCENTRATED GR-S LATEX (58%)

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AKRON

E. P. LAMBERT CO.
FIRST NATIONAL TOWER
AKRON 8, OHIO
HEmlock 2188

Automotive Pneumatic Casings

(Thousands of Units)

	Shipments					
	Original Equipment	Replacement	Export	Total	Production	Inventory End of Period
1935 (total)	19,263	29,406	1,514	50,183	49,362	8,196
Passenger Car	17,063	26,036	948	44,047	43,256	7,054
Truck and Bus	2,200	3,370	566	6,136	6,106	1,142
1936 (total)	21,446	30,866	1,073	53,385	56,041	10,717
Passenger Car	18,941	26,999	644	46,584	49,013	9,291
Truck and Bus	2,505	3,867	429	6,801	7,028	1,426
1937 (total)	22,353	29,886	1,246	53,485	53,310	10,383
Passenger Car	20,055	26,177	696	46,928	46,497	8,745
Truck and Bus	2,298	3,709	550	6,557	6,813	1,638
1938 (total)	11,516	30,567	1,049	43,132	40,907	8,451
Passenger Car	10,086	27,104	580	37,770	35,789	6,937
Truck and Bus	1,430	3,463	469	5,362	5,118	1,514
1939 (total)	18,208	38,022	1,279	57,509	57,613	8,665
Passenger Car	15,742	33,471	607	49,820	49,933	7,108
Truck and Bus	2,466	4,551	672	7,689	7,680	1,557
1940 (total)	22,252	35,346	1,176	58,774	59,186	9,127
Passenger Car	19,560	30,903	411	50,874	50,965	7,270
Truck and Bus	2,692	4,443	765	7,900	8,221	1,857
1941 (total)	24,780	39,895	1,489	66,164	61,540	4,436
Passenger Car	19,855	34,119	586	54,560	50,392	3,165
Truck and Bus	4,925	5,776	903	11,604	11,148	1,271
1942 (total)	6,680	8,872	207	15,759	15,351	6,247
Passenger Car	910	2,734	38	3,682	2,790	4,432
Truck and Bus	5,770	6,138	169	12,077	12,561	1,815
1943 (total)	6,128	18,547	225	24,900	20,423	1,883
Passenger Car	82	10,606	71	10,759	7,620	1,132
Truck and Bus	6,046	7,941	154	14,141	12,803	751
1944 (total)	6,654	26,439	273	33,356	33,446	2,013
Passenger Car	208	18,330	130	18,668	18,819	1,218
Truck and Bus	6,446	8,109	133	14,688	14,627	795
1945 (total)	5,984	36,479	504	42,967	44,524	3,077
Passenger Car	1,115	25,463	222	26,800	28,200	2,214
Truck and Bus	4,869	11,016	282	16,167	16,324	863
1946 (total)	15,310	65,490	1,512	82,312	82,298	2,448
Passenger Car	11,086	54,684	653	66,423	66,466	1,763
Truck and Bus	4,224	10,806	859	15,889	15,832	685
1947:						
March (total)	2,457	5,142	293	7,892	8,577	4,516
Passenger Car	1,875	4,343	152	6,371	6,973	3,518
Truck and Bus	582	799	141	1,521	1,604	998
April (total)	1,894	5,063	316	7,273	8,333	5,608
Passenger Car	1,464	4,241	155	5,859	6,711	4,400
Truck and Bus	430	822	161	1,414	1,622	1,208
May (total)	2,005	4,917	361	7,283	8,104	6,426
Passenger Car	1,603	4,087	190	5,190	6,526	5,039
Truck and Bus	402	830	171	1,393	1,578	1,387
June (total)	2,130	5,094	302	7,526	7,583	6,345
Passenger Car	1,716	4,345	146	6,207	6,102	4,834
Truck and Bus	414	749	156	1,319	1,481	1,511

Source: The Rubber Manufacturers Association, Inc.

Cotton, Rayon and Nylon Tire Fabrics

(Production in Thousands of Pounds)

	Cotton				Rayon and Nylon [a]		
	Tire Cord Not Woven	Cord Fabric Woven	Chafer and All Other Tire Fabrics	Total	Tire Cord Not Woven	Tire Cord And Other Tire Fabrics	Total
1943:							
Jan.-Mar.	11,155	34,287	7,819	53,261	564	9,833	10,397
Apr.-June	11,625	34,684	8,549	54,858	1,253	10,185	11,438
July-Sept.	15,754	36,854	9,618	62,226	1,220	9,184	10,404
Oct.-Dec.	15,928	42,639	10,464	69,031	1,806	12,055	13,861
Total	54,462	148,464	36,450	239,376	4,843	41,257	46,100
1944:							
Jan.-Mar.	17,135	42,783	11,452	71,370	1,812	15,830	17,642
Apr.-June	17,587	40,580	11,499	69,666	1,353	19,586	20,939
July-Sept.	16,653	38,462	11,055	66,170	1,299	25,915	27,214
Oct.-Dec.	12,982	34,107	10,948	58,037	2,773	33,630	36,403
Total	64,357	155,932	44,954	265,243	7,237	94,961	102,198
1945:							
Jan.-Mar.	16,671	43,835	12,306	72,812	3,726	37,777	41,503
Apr.-June	16,044	42,383	13,604	72,031	4,064	42,476	46,540
July-Sept.	15,136	38,158	14,122	67,416	3,549	42,606	46,155
Oct.-Dec.	15,514	36,442	13,573	65,529	a	47,734	47,734
Total	63,365	160,818	53,605	277,788	11,339	170,593	181,932
1946:							
Jan.-Mar.	17,128	39,377	15,245	71,750	a	51,208	51,208
Apr.-June	19,622	40,197	18,623	78,442	a	52,511	52,511
July-Sept.	17,279	39,259	18,787	75,325	5,102	46,932	52,034
Oct.-Dec.	20,660	42,668	21,708	85,036	5,858	50,589	56,447
Total	74,689	161,501	74,363	310,553	10,960	201,240	212,200

Source: U. S. Bureau of the Census.

Notes: (a) Included with tire cord and fabrics to avoid disclosures of operations of individual mills. (b) Fuel cell fabrics are not included with rayon and nylon tire cord and fabrics.

Automotive Inner Tubes

(Thousands of Units)

	Shipments					
	Original Equipment	Replacement	Export	Total	Production	Inventory End of Period
1935	19,218	28,095	754	48,067	47,879	8,231
1936	21,514	32,188	721	54,423	57,036	10,945
1937	22,464	29,554	749	52,767	52,373	10,312
1938	11,515	28,134	644	40,293	37,848	8,166
1939	18,190	31,998	1,002	51,190	50,649	7,036
1940	22,172	29,070	972	52,214	52,237	7,017
1941	24,722	33,749	1,232	59,703	57,433	4,686
1942	n.a.	n.a.	n.a.	13,958	12,568	5,742
1943	6,183	12,373	176	18,732	15,260	2,584
1944	6,461	19,739	190	26,390	26,750	2,823
1945	6,119	33,161	408	39,688	41,102	3,671
1946	15,327	59,357	1,424	76,108	77,251	3,820
1947:						
Jan.	1,922	5,085	181	7,188	8,720	5,075
Feb.	2,129	3,988	171	6,289	7,841	6,621
Mar.	2,460	3,740	266	6,466	7,921	8,050
Apr.	1,897	3,510	324	5,731	7,093	9,480
May	1,980	3,268	323	5,571	5,752	9,772
June	2,154	3,364	260	5,778	5,440	9,252

Source: The Rubber Manufacturers Association, Inc.
n.a.—Not available.

Smoked Sheets—Spot Closing Prices

(New York Market—Cents per pound)

Year	High	Low	Avg.	Year	High	Low	Avg.
1910	288	141	206.60	1929	26⅜	15½	20.55
1911	184	114	141.30	1930	16½	7½	11.98
1912	140	108	121.60	1931	8¾	4¾	6.17
1913	113	59	82.04	1932	4¾	2½	3.49
1914	93	56	65.33	1933	9⅜	2¾	5.96
1915	79	58½	65.85	1934	15¾	8¾	12.92
1916	102	55	72.50	1935	13¾	10½	12.37
1917	90	52	72.23	1936	23	13½	16.41
1918	70	40	60.15	1937	26⅜	14	19.39
1919	57	38½	48.70	1938	17⅞	10⅛	14.64
1920	56½	16	36.30	1939	24	14⅛	17.57
1921	21¼	11½	16.36	1940	24	18¼	20.10
1922	28¾	13¾	17.50	1941	24⅞	19½	22.40
1923	37⅛	24¾	29.45	1942	22½	22½	22.50
1924	40⅛	17⅝	26.20	1943	22½	22½	22.50
1925	121	34¾	72.46	1944	22½	22½	22.50
1926	88½	36¾	48.50	1945	22½	22½	22.50
1927	41¾	33	37.72	1946	22½	22½	22.50
1928	41¾	17	22.48				

Note: Price was fixed by Government on August 6, 1941, at 22½c a pound for non-war uses.

Spot Closing Cotton Prices

(Middling Upland Grade—New York Market—in Cents)

Average Monthly Price Per Pound

	1940	1941	1942	1943	1944	1945	1946	1947
Jan.	11.19	10.66	19.85	21.34	20.76	22.36	25.49	32.58
Feb.	11.10	10.87	20.05	21.61	21.34	22.39	26.57	33.91
Mar.	10.90	11.08	20.42	21.98	21.65	22.43	27.52	35.89
Apr.	10.89	11.48	21.10	22.02	21.71	21.88	28.40	35.89
May	10.33	12.97	20.88	21.97	21.63	23.30	28.17	36.51
June	10.72	14.66	19.78	21.92	22.31	23.42	29.89	37.83
July	10.42	16.55	20.27	21.46	22.33	23.27	34.11	38.03
Aug.	9.84	17.06	19.45	21.09	22.11	23.10	36.31	34.83
Sept.	9.69	17.94	19.62	21.10	22.10	23.25	37.59	....
Oct.	9.62	17.31	19.79	21.00	22.32	23.85	36.79	....
Nov.	9.97	17.21	20.21	20.32	22.13	24.71	31.50	....
Dec.	10.18	18.09	20.55	20.32	22.28	25.21	33.03	....
Average for Year	10.40	14.66	20.16	21.34	21.89	23.25	31.28	....

Consumption of Vinyl Resins

(In Thousands of Pounds)

	Sheeting and Film [a]	Textile and Paper Coating Resins [b]	Molding and Extrusion Materials [b]	All Other [b, c]
1946	52,080	11,673	61,852	27,083
1947:				
Jan.	6,197	1,237	6,802	3,097
Feb.	5,131	892	5,345	2,255
Mar.	5,853	1,142	6,922	3,081
Apr.	5,981	1,425	6,890	2,021
May	4,431	1,432	5,777	1,486
June	3,915	1,084	4,937	1,611
July	3,722	1,537	4,567	1,747
Aug.	....	....	....	....
Sept.	....	....	....	....
Oct.	....	....	....	....
Nov.	....	....	....	....
Dec.	....	....	....	....

Source: Bureau of the Census.

Notes: (a) Includes weight of fillers, plasticizers, extenders and safety glass sheeting; (b) Resin content; (c) Includes Adhesives, but excludes data for protective coating resins.

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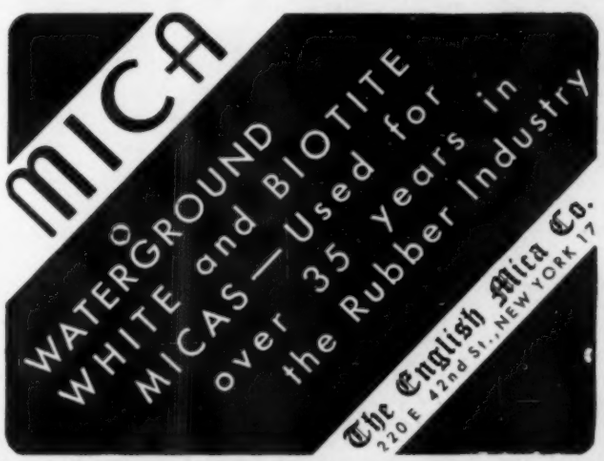
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Rubber Industry Employment, Payrolls, Wages and Hours

Employment — Thousands of Production Workers and Index (1939 = 100)

Month	1946 All Rubber Products Number	1946 All Rubber Products Index	1946 Rubber Tires & Tubes Number	1946 Rubber Tires & Tubes Index	1947 All Rubber Products Number	1947 All Rubber Products Index	1947 Rubber Tires & Tubes Number	1947 Rubber Tires & Tubes Index
Jan.	209	172.7	99	182.4	240	198.8	110	203.5
Feb.	214	177.1	101	187.3	240	198.2	109	201.2
Mar.	220	181.5	104	191.6	238	196.5	108	199.2
Apr.	217	179.1	104	192.8	234	193.5	106	195.0
May	217	179.7	105	193.4	223	184.2	102	188.7
June	221	182.9	106	195.8	...	....	...	....
July	214	177.0	99	183.1	...	....	...	....
Aug.	223	184.0	103	189.9	...	....	...	....
Sept.	229	189.1	107	197.0	...	....	...	....
Oct.	236	194.8	110	204.0	...	....	...	....
Nov.	240	198.8	112	207.0	...	....	...	....
Dec.	242	200.1	112	206.3	...	....	...	....

Payrolls — Production Workers Pay Rolls Unadjusted Index (1939 = 100)

Month	1945 All Rubber Products	1945 Rubber Tires & Tubes	1946 All Rubber Products	1946 Rubber Tires & Tubes	1947 All Rubber Products	1947 Rubber Tires & Tubes
Jan.	323.2	342.4	290.1	272.6	386.3	361.2
Feb.	323.6	339.8	292.1	271.9	385.0	357.7
Mar.	315.4	301.9	298.2	281.1	374.3	343.2
Apr.	315.9	306.0	319.7	312.9	383.9	359.2
May	299.8	288.6	322.1	314.2	371.2	349.0
June	304.3	293.8	331.4	318.3	....	....
July	298.7	286.8	321.4	304.3	....	....
Aug.	231.3	211.4	336.9	311.2	....	....
Sept.	231.3	211.4	363.9	348.9	....	....
Oct.	254.2	239.8	361.3	346.1	....	....
Nov.	257.8	240.2	377.4	360.3	....	....
Dec.	275.5	256.7	392.2	368.9	....	....

Wages — Average Weekly Earnings

Month	1945 All Rubber Products	1945 Rubber Tires & Tubes	1946 All Rubber Products	1946 Rubber Tires & Tubes	1947 All Rubber Products	1947 Rubber Tires & Tubes
Jan.	$54.49	$64.29	$46.71	$50.29	$54.03	$59.78
Feb.	54.40	64.04	46.05	49.21	54.06	59.90
Mar.	50.62	57.29	46.46	49.72	52.97	58.05
Apr.	51.93	59.75	49.67	54.77	55.23	61.64
May	50.09	57.32	49.82	54.72	55.30	61.12
June	51.45	59.20	50.45	54.82	55.49	61.35
July	51.81	59.59	50.60	56.11	....	....
Aug.	46.76	52.81	51.03	55.42	....	....
Sept.	47.20	53.59	53.69	59.89	....	....
Oct.	45.57	49.48	51.74	57.38	....	....
Nov.	44.68	47.78	52.93	58.87	....	....
Dec.	45.48	48.54	54.63	60.46	....	....

Wages — Average Hourly Earnings

Month	1945 All Rubber Products	1945 Rubber Tires & Tubes	1946 All Rubber Products	1946 Rubber Tires & Tubes	1947 All Rubber Products	1947 Rubber Tires & Tubes
Jan.	$1.151	$1.317	$1.121	$1.255	$1.330	$1.511
Feb.	1.149	1.314	1.129	1.266	1.331	1.517
Mar.	1.117	1.260	1.138	1.275	1.330	1.512
Apr.	1.136	1.294	1.232	1.414	1.397	1.608
May	1.132	1.284	1.266	1.446	1.416	1.622
June	1.140	1.307	1.283	1.461	1.419	1.615
July	1.138	1.296	1.292	1.472	....	....
Aug.	1.119	1.269	1.295	1.474	....	....
Sept.	1.098	1.243	1.323	1.507	....	....
Oct.	1.100	1.231	1.313	1.492	....	....
Nov.	1.112	1.249	1.322	1.503	....	....
Dec.	1.113	1.247	1.331	1.513	....	....

Hours — Average Weekly Hours per Worker

Month	1945	1946	1947	Month	1945	1946	1947
January	47.3	41.7	40.6	July	45.5	39.2	...
February	47.3	40.8	40.6	August	41.8	39.4	...
March	45.3	40.8	39.8	September	43.0	40.6	...
April	45.7	40.3	39.5	October	41.4	39.4	...
May	44.2	39.4	39.0	November	40.2	40.1	...
June	45.2	39.3	39.1	December	40.9	41.2	...

Source: U. S. Department of Commerce.

Indexes of Producuon, Shipments and Inventory For The Rubber Industry

Production 1935-1939 = 100 (Based on man-hours)

Month	1945	1946	1947	Month	1945	1946	1947
Jan.	247	215	247	July	218	211	....
Feb.	247	216	246	Aug.	193	221	....
Mar.	236	221	239	Sept.	172	234	....
Apr.	233	219	234	Oct.	191	234	....
May	224	215	220	Nov.	192	243	....
June	222	218	213	Dec.	205	252	....

Shipments—Average Month 1939 = 100 (Based on $ Value)

Jan.	311	229	290	July	274	268	....
Feb.	351	242	315	Aug.	255	282	....
Mar.	351	260	322	Sept.	200	311	....
Apr.	356	282	311	Oct.	260	333	....
May	333	288	....	Nov.	212	313	....
June	333	293	....	Dec.	292	352	....

Inventory — Average Month 1939 = 100 (Based on $ Value)

Jan.	170.6	173.7	238.0	July	183.3	195.0	....
Feb.	176.7	179.9	250.0	Aug.	182.4	198.0	....
Mar.	175.5	186.4	262.0	Sept.	177.4	204.0	....
Apr.	175.3	198.5	273.0	Oct.	167.7	212.0	....
May	178.3	195.5	....	Nov.	167.1	215.0	....
June	178.7	192.4	....	Dec.	169.0	216.0	....

Source: U. S. Department of Commerce.

Various Compounding Materials Consumed by the Rubber Industry

Material	1940	1941	1942	1943	1944	1945	1946
Asphalt [a]							
Short tons	22,772	20,536	22,263	16,510	20,189	19,483	28,715
% of total	0.9	0.6	0.6	0.5	0.6	0.5	0.7
Barite (Barytes):							
Short tons	4,283	9,800	6,334	8,000	10,000	10,000	20,000
% of total	2.3	4.2	3.6	3.9	2.9	2.1	4.4
Carbon Black:							
Short tons	155,090	219,751	147,974	236,737	369,015	402,193	470,732
% of total	58.5	68.2	65.8	75.2	78.7	78.9	74.1
Clay, Kaolin:							
Short tons	92,640	127,055	51,334	50,964	59,588	109,936	162,393
% of total	11.1	11.6	5.1	5.5	6.8	11.7	12.3
Clay, Fire & Stoneware:							
Short tons	10,104	9,000	5,000	10,259	7,160	7,800	12,951
% of total	0.4	0.2	0.1	0.2	0.1	0.1	0.2
Lead Sulfate, Basic:							
Short tons	128	200	89	131	268	200	.....
% of total	2.1	1.9	1.1	2.3	4.2	5.2	.....
Lime:							
Short tons	1,879	3,058	1,381	2,039	5,634	7,170	3,193
% of total	0.03	0.05	0.02	0.05	0.13	0.10	0.1
Litharge:							
Short tons	1,590	3,968	3,460	4,302	3,023	1,864	2,131
% of total	1.8	3.3	3.8	3.8	2.2	1.3	1.6
Lithopone:							
Short tons	3,387	3,547	1,047	1,078	726	977	1,607
% of total	2.2	2.0	0.8	0.8	0.5	0.7	1.1
Mica, Ground:							
Short tons	1,731	3,476	1,754	3,063	1,137	3,715	4,951
% of total	6.2	8.0	3.7	6.0	2.2	7.0	10.6
Sulfur:							
Short tons	54,000	63,000	40,000	51,000	63,000	64,960	72,800
% of total	2.5	2.4	1.4	1.8	1.9	2.0	2.2
Talc [b]							
Short tons	28,501	58,114	40,487	48,994	51,833	63,758*	65,980
% of total	10.0	13.9	10.0	11.8	13.0	16.0	14.4
Zinc Oxide:							
Short tons	70,979	90,429	52,717	67,898	59,518	63,447	83,776
% of total	62.8	63.4	53.0	47.4	42.3	49.6	53.1

Source: U. S. Bureau of Mines.

Notes: (a) Solid and semi-solid products of less than 200 penetration. (b) Includes pyrophyllite and ground soapstone. * Revised.